THE FARM BOOK

A GUIDE TO BETTER FARMING WITH BETTER BUILDINGS

$1.00

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A GUIDE TO BETTER FARMING WITH BETTER BUILDINGS

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WEST COAST WOODS

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The source material for this publication was prepared by B. G. Perkins and his associates of the Doane Agricultural Service, Inc., St. Louis, Missouri.

Acknowledgment is made to the many agricultural colleges, experimental stations, and the United States Department of Agriculture for the fine cooperation of their personnel and for the research data drawn upon.

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TO OUR FARM FRIENDS:

Do you know *how your farm buildings can make money?*

Do you know *how much a dairy cow, a beef cow, sow, or hen can pay for the use of a building?*

Do you know *about the newest labor-saving methods and improvements—for example, how one man can raise 400 hogs with only two months of work?*

These and *many* other basic facts are on the pages which follow. Now, for the first time, tested methods, figures, and facts for planning new buildings and remodeling the old ones are available to every farmer, builder, and user of farm buildings.

This handbook material has been prepared for us by the Doane Agricultural Service, Inc., of St. Louis, Missouri. Their 26 years of experience in operating thousands of farms on the basis of making them pay has gone into it. Only by *actually using, planning, and rearranging farm buildings* and trying new methods and ideas, has it been possible for them to eliminate or reduce time-consuming jobs, increase volume, and make buildings real money-making tools.

We are making this handbook available to farmers, through their local lumber dealers, in the interest of economically, efficient, sound, and practical buildings for the future.

USE IT — KEEP IT — and profit from its use.

WEST COAST WOODS
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PORTLAND 5, OREGON

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CHAPTER 1

FARM BUILDINGS MAKE MONEY

Buildings work . . . they create and preserve income. If well-planned and properly arranged, they are as much an asset and just as good an investment as machinery, tools, or livestock.

We used to think of a building as a static thing. Once built, it stood as a monument to the builder. It was not supposed to add to farm income, yet it was a necessary part of the farm. Now we *know* buildings are in reality a kind of farm machine—a tool. They *work, earn, increase yields, and do many useful time-saving jobs.*

No farmer would buy just any old kind of farm machine. Even more care should be taken in planning his buildings—they last longer, and can have a greater effect on farm profits.

Buildings Increase Stock and Crop Yields

Buildings increase stock yields by making it possible to save more chicks, hogs, or calves. When properly constructed, they are an aid in keeping down disease hazards, which in turn means more stock to market.

A crib or bin that is rat- and mouse-proof prevents loss from these pests, leaving more grain to sell. Hay, properly stored in a barn or shed that keeps out rain, will turn out more tons of sound, properly cured roughage at the end of the year.

Yes, buildings increase yields.

Buildings Increase Effectiveness of Labor

No one is more certain that a modern poultry or brooder house will save labor than the farm woman who has had little or poor equipment and then experienced the thrill of modern houses. She knows the steps that have been saved. Fewer hours have been required to water and feed the chickens, and certainly, that disagreeable job of keeping equipment clean has been cut down tremendously.

A farmer who has fed hogs by hand twice a day need not be told he has saved labor by installing a self-feeder.

The difference between handy feeding and caring for a flock of ewes at lambing time and a poor arrangement that requires extra walking, accounts for many hours during the year. Cattle barns equipped with feed hoppers where grain can go directly into feed bunks, and which are designed to accommodate manure power-loading equipment, save many hours, yes, even days, compared to handling feed in buckets and pitching manure out of windows into piles and then reloading before going to the field.

Buildings Increase Value of Products

The dairy farmer who reorganized his dairy barn and milk house, to enable him to sell whole milk, as contrasted to sour cream, can attest to the truth of the statement that proper buildings increase value of products.

Easter lambs are not possible without proper housing for ewes and lambs during winter weather. A normal premium of $2.00 per hundred pounds over ordinary spring lambs is paid for the Easter crop.

Cribs that prevent spoilage of corn, silos that keep all the silage in feedable condition, and dairy barns and milk houses that do their part in keeping bacteria counts low, all contribute to a better quality product, and higher prices.

Buildings Increase Volume Handled

Some buildings make it possible for the operator to carry *twice the volume* of livestock and poultry *without increasing labor*—in some cases three times more. If volume is doubled, the profits are normally three or four times greater. This is readily recognized by the man who can feed and care for 50 steers as easily as he formerly handled 25 head without labor-saving improvements. The saving of labor often may mean the difference between a profit or no profit at all.

There are many factors which determine farm profits. The three most important are:

1. High crop yields,
2. Efficiency of handling livestock, and
3. Numbers of livestock and poultry handled—*volume.*

Returns per head are usually small; therefore, *large numbers* must be handled for substantial profits. The volume one man can handle and the simplicity of doing the necessary jobs are determined almost entirely by the building arrangement and design. Feed must be moved both in and out of cribs and granaries—roughage must be stored and fed out again to livestock—barns must be kept well bedded and manure hauled to fields—and livestock must have adequate water at all times.

Although an hour saved per day is equivalent to eliminating a full month's work per year, the time saved will usually give greatest returns if it is used to increase the volume handled.

An entire bin used as a grain self-feeder and a self-feeding hay arrangement makes it possible for one man to care for a large number of steers. Grain self-feeder should feed only as cattle lick, leaving no grain in the trough to be slobbered over. The fence-type hay feeder where cattle reach through into the hay-holding area is preferred to the one shown in the picture, because it requires less attention and reduces feed wastage.

Buildings Add to the Comfort of Operator and Stock

In the North, buildings are constructed for warmth in winter and in the South they are made cool in summer. This not only adds to the comfort of the worker, but the stock as well. Ordinarily livestock does not require exceedingly warm buildings even in winter. The building that prevents or modifies *extremes* in temperature and provides adequate ventilation fulfills its requirements. If a choice must be made between warmth and ventilation, choose the latter. No stock can do well in poorly ventilated stalls and sheds. Nature has provided warm coats for most animals and proof that they are adequate, even during very cold weather, is seen when animals frequently sleep and stand outside by choice rather than in poorly ventilated buildings. Tight construction demands ventilating systems. If and when they fail, trouble starts. Buildings that may appear rather open and "airy" are safer than tight, poorly ventilated buildings. If building plans call *only for protection from extremes*, both man and animals will suffer less, the health of stock will be improved, and costs will be held down.

Properly planned buildings are a good investment. They work, perform, do jobs, increase yields, save stock and crops, add to the comfort of man and beast, and add to the beauty of the farm landscape.

CHAPTER 2

DETERMINING TYPE AND SIZE OF BUILDINGS

How Long Should Buildings Last?

"The longer the better—at least fifty years," no doubt most farm owners would answer. All agree that no one wishes to build so poorly that the structure will begin failing soon after erected or fall apart when hit by hard winds. The goal should be *most years of use for the least cost.* A farmer once said, "I don't want longest life because that would cost too much. I could build a barn that might last for one or two hundred years, as some barns have in England. On the other hand, I could build it so poorly that it might not serve its purpose even for one year. I want good, sensible buildings that will give me the best return for the dollars I put into them."

The Ford Motor Company makes automobile parts out of soybeans. Someone asked the late Mr. Henry Ford if the parts were better than those previously used, which were made of metal. "No," he said, "they are not better but they are good enough. There would be little sense in making a gear shift knob so strong that it would last fifty years if the car as a whole was only intended to operate for ten or perhaps fifteen years. We try to build a well-balanced car—one that will give the most years of use for the least money."

The same reasoning should be applied to buildings—*figure about how long the structure should last; then try to make all parts have about the same life.*

There is another factor about the life of a building that should not be overlooked. It has to do with obsolescence—going out of date.

Swinging doors should be avoided because they usually "go to pieces" first. When they are used they should be constructed to match, as near as possible, the life span of the rest of the building. Note the 2" x 4" stiffening braces which will add life to these lightweight doors.

All good farmers know how the increase in hog diseases has almost put the old central hog farrowing house out of business, and the tractor shed has frequently displaced the horse stall. All of this adds up to "the high cost of out-of-date equipment." Perhaps the auto manufacturer, with a new model each year, has had a lot to do with keeping us modern. The tractor dealer has also played his part. A good farm operator said, "I don't want to own a tractor more than five years. I plan to so use my tractors that they are ready to trade in by that time. New makes, improvements, economy of fuel consumption and the new tools all make the old tractor increasingly expensive to own. Why, I traded in one tractor not long ago and the one I got in its place did 20 per cent more work, did it better, and at less cost. If I had kept the old one it would have been equivalent to paying a 20 per cent tax per year on it. I can't afford such expensive luxuries."

If that idea applies to autos, trucks, tractors, and combines, why does it not also apply to buildings?

The out-of-date barn, hog house, or feeding shed can be just as expensive as the out-of-date machine. If a new barn can save two hours a day in feeding or caring for livestock throughout the year, those two hours are even more important than the two hours saved in the field, because the hours spent around the farmstead reoccur 365 times a year and thus add up to a larger total saving. Then too, the saving of time at the farmstead makes more time available for critical seasonal field work.

A well-planned horse barn served its purpose well because it was built for horses. As a tractor or machine shed it is a failure. Yet, many tractors and other equipment are still handled through buildings designed for horses and mules. A sow can farrow in a horse stall; however, a real dividend is received if two additional pigs per litter are saved by providing a modern hog house.

The income tax authorities now recognize the necessity for keeping buildings and machinery up to date. They permit one to depreciate them from 5 to 20 per cent per year. This means that a barn depreciated at 5 per cent a year is entirely written off the books in 20 years, and a machine that takes a 20 per cent rate is written off in five years. Thus from an income tax standpoint the owner of a new barn may take a 100 per cent deduction, as an expense against income, over a period of 20 years. Not only does the modern structure pay for itself in saving of time, and increasing volume and value of products, but there is also a substantial saving in income taxes.

Perhaps no one can say just how long any particular building should last. Something can be said on the subject, however, that calls for very practical consideration by every farmer:

1. Build the most building for the least cost.
2. Build a well-balanced structure so that all parts will last approximately the same length of time.
3. Do not build so expensively or permanently that new and modern ideas cannot be taken advantage of as they come along. It is as important to keep buildings up to date as it is autos, tractors, and other farm machines.
4. Where possible, design buildings for many uses.
5. Depreciate buildings as rapidly as taxing authorities will permit, so that old structures are written off as rapidly as possible.

How long should farm buildings last? Long enough to pay for themselves and give a good return on the investment, but not so long that they become obsolete and their cost is greater than their return.

Use-Experience Determines Building Design

The architect, engineer, farm carpenter, and the farmer himself all may have a hand in making plans for farm buildings. The man who uses the building should have the most to say about its planning. There are two important reasons why his voice should be heard above the others. First, the experience gained in actual use of farm buildings is the best background for properly constructing them. Second, *he must use the buildings* and make them pay.

It was use-experience that changed the stanchion dairy barn into small milking quarters combined with the loafing shed. Hauling out manure and cleaning the barn at least once each day, the difficulty of keeping the cows clean, and the development of big knee and udder trouble because cows had to stay in stanchions throughout the long winter months, made someone think of a better way for housing cows.

(D.A.S. Photo)

Clearly, it is dangerous to have livestock go back and forth across high sills such as shown in this picture, and sometimes it is almost impossible to get strange livestock to go over them.

If the man who planned the small individual hog house had used it during farrowing time when it seemed necessary to get into the house with an ugly sow because of some difficulty between sow and pigs, then it is probable that he would have set his head to work on a hog house which would overcome this difficulty. When the weather is below zero and the one who is caring for the sows has to stay out in the cold while feeding and watering, he realizes the necessity for effective shelter for the hogs, and, at the same time, the advantage of being able to work inside of the building out of the weather.

Lumber companies have recognized the importance of use-experience and are now working with farmers and farm managers in designing modern, practical buildings

"Most failures of farm structures are due to improper foundations, insufficient or entire lack of anchorage of the frame to foundations, or of the roof to the frame, or insufficient bracing of the frame." U.S.D.A. Leaflet No. 77.

Buildings Should Have Many Uses

On some farms there is need for special tools and implements. Every farmer knows, however, that the fewer days he uses a machine, the greater the cost per unit of operation. The solution is, of course, more use. This is not a problem of machines alone. Buildings are tools made to be used. Limited use means high cost; full or complete use means lower cost. The best way to assure full use is to plan many possible uses when the building is designed. Tractor manufacturers say that a tractor should be used at least 1,000 hours a year. We may say that a service building should be used at least 8,000 hours per year. It takes good planning to make a building so *versatile* that it can be used as intensively as that. It must be adapted to many *different* uses.

(D.A.S. Photo)

This low-cost open shed can be used for beef cattle, sheep, hog shelter, machinery, and hay. By adding a two or four-cow milking room, it will serve as an excellent loafing area for dairy cattle.

Flexibility is another feature that adds to constant use. A machine shed that will let only a five-foot implement through the door would have limited use. By making the door ten feet wide, more machines might be stored.

A hog house that may be used only for farrowing has limited use. If the sides can be raised so that it will also serve as a shade, then this flexible feature adds to its hours of use—hence lowers its use-cost.

This same principle has many applications and all sound building planning includes it. Specialty buildings are hard to change to other or alternate uses.

Buildings Should Be Well Ventilated

Livestock and poultry have a wide range of tolerance as far as ventilation is concerned. Yet, little is known concerning the true limits of their requirements. *The inside temperature of barns and sheds,* especially for beef cattle and sheep, *should be close to the outside temperature.* This has often been overlooked, resulting in unnecessarily heavy expenditures for improvements that were actually more harmful than beneficial to the livestock.

Ventilation can be made very simple or quite complicated. The simple method, and lowest cost, is usually the most practical. It consists of open or partially open sheds and buildings. The complicated method is used too often in tightly closed buildings, without knowledge of the principles and requirements involved. It restricts air movements to inlets and outlets by either gravity ventilation or forced ventilation.

The kind of ventilation to be used in a building determines to no small degree the type of structure. Before deciding on the type of building to construct, it would be well to look over "Ventilation Construction Features" in Chapter 6 to have a clear idea of the work and cost involved for installing and operating the different systems.

Buildings Should be Planned for Sanitation

It is often said that sanitation depends entirely upon management; however, the determining factors hinge on available buildings that make it convenient and easy to carry out a sanitary program.

Broiler producers have learned the importance of having buildings and equipment which enable them to start with large numbers at one time and then clear them out at the same time. This gives an opportunity for thorough cleaning and breaking of disease cycles.

Photograph courtesy Minnesota Agricultural Extension Service

Portable equipment is an essential part in practical sanitation, especially for profits with poultry and hogs.

Colony hog houses without adequate floors, drains, outside feeding platforms, and washing and disinfecting facilities will sooner or later cause disease and parasite difficulties. On the other hand, sanitary control is easily maintained when portable equipment with removable floors is used. Such structures can be conveniently cleaned, disinfected, and moved to clean ground.

In determining type and size of buildings as related to sanitation and livestock health, consideration should be given to the following main features:

1. *Disease*—Portable buildings make it possible to keep livestock and poultry healthy by moving to clean ground.
2. *Manure*—Easy to remove by large drive-through doors, clearance for power loader, screen floors (poultry), removable floors (hogs), litter chutes.
3. *Bedding*—Storage of bedding where it will be used, no hauling.
4. *Ventilation*—Plenty of fresh air by using open sheds, partially open south sides, large inlets and outlets, forced ventilation with electric fans.
5. *Light and Sunshine*—Open sheds.
6. *Clean, dry ground*—Portable structures, drainage of roof water.
7. *Dry floors*—Built-up litter and bedding, drainage, ventilation, sunshine, watering system.
8. *Disinfecting*—Smooth walls, drains, sufficient height for good head clearance.
9. *Dust*—Reduce by portable structures, easy removal of manure, convenient method of bedding.

GENERAL FACTORS AFFECTING TYPE AND SIZE OF BUILDINGS

Kind and Fertility of Soils

The soil, which determines value, also determines the size and type of farm structures which are justifiable. In some cases soil fertility has been depleted by heavy grain cropping and insufficient livestock feeding because of lack of buildings. Inherently good soil will justify the construction of larger buildings than will inherently poor soil.

Crops, Livestock and Markets

The actual crops to be grown and livestock handled finally determine the details of size and type of buildings. Usually there are several alternatives, and care should be exercised in the selection of enterprises. Farms with extensive pasture areas should provide buildings for maximum use of livestock; likewise, farms with areas suited mainly to crop production should first provide storage space for the crops produced.

(D.A.S. Photo)

A combination machine shed, garage, and shop all under one roof. Note double track rolling doors.

(D.A.S. Photo)

Rear view of same building. Note window in gable end to furnish light in the loft storage area, and large hinged doors at far gable end for admitting equipment too high to go under rolling doors.

Size of Farm

The size of farm affects the type and size of buildings only as it relates to the amount of products to be stored and livestock sheltered in them. The basic space requirements in Chapter 9 will serve as a guide for calculating the size required to handle the crops and livestock. Allowance should be made for additional space required on those farms where home-grown grains and roughages are supplemented with purchased feeds.

Kind of Operation

Whether a farm is to be operated by owner or tenant influences the practical size and types of buildings. In general, buildings on tenant-operated farms should be confined to a good substantial set for handling the typical crops and livestock of the area, and on owner-operated farms more extensive and more highly specialized building set-ups are often desirable.

Size of the family and their interests also influence type and size of buildings. A large family can increase their volume of production by more extensive buildings and more intensive handling of livestock. It should be remembered, however, that the work capacity of a family expands as the children grow up and contracts as they leave home and go out for themselves.

Type of Farming

Normally it is advisable to have buildings which will meet or be easily changed to conform to the requirements of the main income producing enterprises that are dominant of the area, and suitable to the particular farm.

Personal Preference—Neighborhood Custom

Personal preference and neighborhood custom have some influence on size and type of buildings, despite the fact that they do not influence good management or profitable operation one way or the other. Pride of ownership in attractive buildings adds much to farm life and ownership. Therefore, where economic considerations do not limit investment, it is justifiable to build according to personal likes and dislikes. It is better, however, to exercise personal preference in the form of more flexible design, substantial construction, and added beauty, than in large sizes and unusual types of buildings that may not fit typical farming of the area.

Neighborhood custom usually has greater influence on type and size of farm buildings than its importance justifies. Contractors and builders are often responsible for local building types as it is easier for them to build structures similar to those they have built before. *So much progress has been made in recent years in building design that anyone now following neighborhood custom in putting up new structures is almost sure to forfeit labor efficiencies and burden himself with unnecessary work.*

Good management is accomplished, not by following someone else, but by analyzing the need and then building to conform to it. *Original thinking,* with due regard for the best farm management plan for the individual farm, will develop buildings well adapted to the job they need to do.

Time has proved generations of American farmers are right when they build with wood. Wood buildings are durable, pleasing in appearance, economical and ideally adapted to modern farming.

CHAPTER 3

CAN LIVESTOCK PAY RENT?

How much can be profitably spent for farm buildings? There are as many answers to that question as there are viewpoints of varying groups. The architect, engineer, contractor, and even the neighbors might each give a different answer. Each will consider the barn from the standpoint of his profession. It would seem reasonable to ask the farmer who must use the barn something about his ideas. His thinking will at once go to the questions of whether or not the barn will pay for itself, how and when it will be used, the effect it will have on the stock using it, and above all, whether or not he can afford it.

Extensive studies have been made to determine how much different kinds of livestock can afford to pay for the use of the barn, feed storage, and the other buildings they need. Results show the approximate percentage of gross annual income from the product of the female that can be devoted to rent, shall we say, for the use of buildings needed by her, the offspring, feed storage and all other building facilities. The amount varies with the kind of livestock—dairy cow, 10 percent; beef cow, 8 per cent; sow, 6 per cent; ewe, 7 per cent; and hen, 9 per cent. This means that if the product from a beef cow, the calf for example, is worth $50.00 at weaning time, then that cow can pay $4.00 a year rent for the buildings she uses.

There are a number of steps that the farmer should take in calculating how much he can put into the buildings needed for the different classes of livestock. To make that job easy, tables have been prepared so that with them the answer can be obtained quickly and accurately. The final total cost is determined by knowing how much annual rent a particular group or herd of animals can pay. Hens that average 200 eggs a year can pay several times as much as a flock that averages 100 eggs a year.

In selecting the figures in the following tables it is well to be conservative. Think of long-time yields and prices. Do not base figures on the best years or war prices. The stock will need, and use, the building just as much when milk sells for $1.50 a cwt. as when it sells for $3.00.

Use actual production and sale records when they are available. Include all income other than that shown in the tables. For unusual cases of high gross income, such as from Pure Bred sales, it is more accurate to use *net* sales.

If an all-purpose barn is wanted, base calculations on those tables that are nearest the ones for the stock that will occupy most of the barn; for single purpose buildings, for such stock as hogs, hens, and dairy cattle, there are specific tables.

In preparing these tables, no attempt has been made to set exact figures which indicate the amount producing animals can pay. They will be most useful to those farm operators who are seeking a *guide* to practical building costs for animal use.

Grade Beef Cows

Methods for using the tables:

1. The left-hand column of figures (the per cent of calf crop) refers to the number of calves raised to weaning time in relation to the number of cows of breeding age. If there are 40 breeding cows, and 30 calves are weaned on the average, that would be a 75 per cent calf crop—75 per cent or ¾ of 40. If 32 calves were raised that would be an 80 per cent calf crop.

2. Across the top is the average weight of *all* calves at weaning time—figure in the runts as well as the tops.

3. Select the line showing proper per cent of calf crop and move to the right until the column showing proper average weight is reached. If, for example, the per cent is 80 and the average weight 350, then stop on 280, which is the number of pounds of calf produced per cow in the breeding herd.

4. Take the 280 figure to the top of the line of Table II and select the figure nearest 280—in this case 300—and move down the column until reaching the average price received at the farm for all the calves based on a fair average. If the price is 7 cents, for example, the figure is $21.00 as income per cow.

5. Carry the $21.00 to the nearest figure in the top line of Table III—in this case $20.00. Follow down to the first line of figures, and that gives the amount of rent the cow can pay per year for the use of all buildings she needs —in this case $1.60.

6. Follow down the same column to the next line of figures and there is the amount which can be spent per cow for the new barn.

7. Follow down to the line nearest the number of breeding cows to be kept. If it is 50 cows of breeding age, then $1,000.00 can be spent for the barn to shelter the 50 cows, bull, heifers, calves, and storage for all the feed which will be put up for them.

8. If the per cent of calf crop, the average weight, or the price is less than calculated above, then the amount spent on buildings must be less; but if any of these three factors are higher, then those cows can afford a more expensive barn. For example, let us select a very good herd of grade beef cows that have averaged near top prices. Let us say—

Calf crop 90%
Average weight . . . . 500 lbs.
Average price 10c

Then Table I shows 450; Table II shows $45.00; Table III, first line $3.60; Second line $45.00; and third line $2,250.00 which is the amount, from a strictly commercial view, that can be spent on a barn for these 50 grade beef breeding cows.

BEEF COWS TABLE I

POUNDS OF BEEF PER COW PER YEAR

Select per cent of calf crop and weight of calves at weaning and follow the columns to where they meet to determine the average pounds of beef produced per cow per year. Carry figure to Table II.

Per cent of calf crop	AVERAGE WEIGHT OF ALL CALVES AT WEANING TIME IN POUNDS							
	250	*300*	*350*	*400*	*450*	*500*	*550*	*600*
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
50%	125	150	175	200	225	250	275	300
55	138	165	193	220	248	275	303	330
60	150	180	210	240	270	300	330	360
65	163	195	228	260	293	325	358	390
70	175	210	245	280	315	350	385	420
75	188	225	263	300	338	375	413	450
80	200	240	280	320	360	400	440	480
85	213	255	298	340	383	425	468	510
90	225	270	315	360	405	450	495	540
95	238	285	333	380	428	475	523	570
100	250	300	350	400	450	500	550	600

DAIRY COWS

The gross income from dairy cows is not difficult to determine. Adding up the milk or cream checks, and the sale of calves, gives the answer. Studies have shown that dairy cows can afford to pay about 10 per cent of their gross income for the use of the buildings in the dairy enterprise. A study of the record of 21,556 cows in six major dairy states showed that costs of operating dairies were as follows (1929-1939):

	Gross cost per year	Per cent of total cost
Feed	$ 68.44	47.1
Labor	33.86	23.3
Building and Equipment Maint.	9.83	6.8
Cow replacement	11.12	7.7
Bull charge	3.21	2.2
Management and Misc.	18.78	12.9
	$145.24	100.0

The tables on the next two pages are to be used in the same manner as the ones on beef cows where a complete explanation was given.

BEEF COWS TABLE II

GROSS INCOME PER COW PER YEAR

Use the Pounds of beef produced per cow, from Table I, and select the average price received for calves to determine gross income per cow per year. Carry figures to Table III.

Price per Pound	POUNDS OF BEEF PER COW									
	150	*200*	*250*	*300*	*350*	*400*	*450*	*500*	*550*	*600*
5c	$ 7.50	$10.00	$12.50	$15.00	$17.50	$20.00	$ 22.50	$25.00	$27.50	$30.00
6	9.00	12.00	15.00	18.00	21.00	24.00	27.00	30.00	33.00	36.00
7	10.50	14.00	17.50	21.00	24.50	28.00	31.50	35.00	38.50	42.00
8	12.00	16.00	20.00	24.00	28.00	32.00	36.00	40.00	44.00	48.00
9	13.50	18.00	22.50	27.00	31.50	36.00	40.50	45.00	49.50	54.00
10	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00
11	16.50	22.00	27.50	33.00	38.50	44.00	49.50	55.00	60.50	66.00
12	18.00	24.00	30.00	36.00	42.00	48.00	54.00	60.00	66.00	72.00
13	19.50	26.00	32.50	39.00	45.50	52.00	58.50	65.00	71.50	78.00
14	21.00	28.00	35.00	42.00	49.00	56.00	63.00	70.00	77.00	84.00

BEEF COWS TABLE III

HOW TO CONVERT GROSS INCOME PER COW PER YEAR TO RENT EACH COW AND HERD CAN PAY FOR NEW BUILDINGS

Bring forward from Table II the amount of gross income per cow per year. Follow down the column from that figure and note the yearly rent the cow can pay. On the next line below in the same column is the amount each cow can pay for her share of the new building. The next figures below show the total amount that normally should not be exceeded for varying sizes of herds.

	GROSS INCOME PER COW PER YEAR															
	$10	*$15*	*$20*	*$25*	*$30*	*$35*	*$40*	*$45*	*$50*	*$55*	*$60*	*$65*	*$70*	*$75*	*$80*	*$85*
Amount of rent one cow can pay per year @ 8% of income	$ .80	$1.20	$1.60	$2.00	$2.40	$2.80	$3.20	$3.60	$4.00	$4.40	$4.80	$5.20	$5.60	$6.00	$6.40	$6.80
Amount each cow can pay for her share of all necessary buildings. (Basis 8% per year for cost of owning and maintaining buildings.)	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00
Amount a herd of cows can pay for a new building.																
10 cows	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850
20 cows	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700
30 cows	300	450	600	750	900	1050	1200	1350	1500	1650	1800	1950	2100	2250	2400	2550
40 cows	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200	3400
50 cows	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500	3750	4000	4250

Table I shows gross income per cow but is based on the price of whole milk per hundred and the annual milk production per cow.

Table II shows the gross income per cow based on annual butterfat production per cow and average price of butterfat to the operator.

In making calculations use either the Whole Milk Table I or Butterfat Table II depending on whether butterfat or whole milk is to be sold.

In using the table it is well to be conservative. When new buildings are too elaborate they constitute a drain on the profits of the enterprise. Additions can always be made as profits and experience justify.

It should be remembered that the total figure showing the amounts that can be spent for a dairy herd of 10, 20 or 50 cows must cover all improvements needed to operate the dairy enterprise up to the point of the milk in the can, cooled, and ready for delivery.

The usual units of a dairy operation are:

Main dairy barn (or loafing barn and milking room)
Bull barn or stalls
Calf barn or stalls
Dry cowsheds.
Young stock shelters
Calving stalls or barn
Isolation barn or shed
Hay storage
Grain bins
Silos
Milk, wash, and cooling room

Some of these facilities can be inexpensive such as open sheds, pit silos, and additional stalls or pens in the main barn.

It takes careful planning to build within the schedules shown. It can be done.

DAIRY CATTLE TABLE I

HOW TO DETERMINE GROSS INCOME PER COW PER YEAR WHEN WHOLE MILK IS SOLD

Select the average pounds of milk produced per cow per year, and the average price anticipated over a period of years, for whole milk, and follow the columns to the figure where they meet to determine the gross milk income per cow per year. Add the calf income per cow (see note at bottom of table) and carry total gross income figure to Table III.

Price received per cwt. for whole milk	AVERAGE POUNDS OF MILK PRODUCED PER COW OF MILKING AGE PER YEAR (*Select the nearest figure*)									
	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000	12,000	15,000
$1.00	$30.00	$40.00	$50.00	$60.00	$70.00	$80.00	$90.00	$100.00	$120.00	$150.00
1.50	45.00	60.00	75.00	90.00	105.00	120.00	135.00	150.00	180.00	225.00
2.00	60.00	80.00	100.00	120.00	140.00	160.00	180.00	200.00	240.00	300.00
2.50	75.00	100.00	125.00	150.00	175.00	200.00	225.00	250.00	300.00	375.00
3.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00	360.00	450.00
3.50	105.00	140.00	175.00	210.00	245.00	280.00	315.00	350.00	420.00	525.00
4.00	120.00	160.00	200.00	240.00	280.00	320.00	360.00	400.00	480.00	600.00
4.50	135.00	180.00	225.00	270.00	315.00	360.00	405.00	450.00	540.00	675.00
5.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	500.00	600.00	750.00

Note: Add to the above calculated figure the average value of calves at one week of age per milk cow owned. For example, if 20 cows of milking age are owned, ten calves are sold per year at $10.00 each, and 5 heifers worth $15.00 are kept, the average figure would be 10 x 10=100
When breeding stock are regularly sold, add the average yearly 5 x 15= 75
income per cow owned less average purchases.

Total 175
20 cows=$8.75 per cow

DAIRY CATTLE TABLE II

HOW TO DETERMINE GROSS INCOME PER COW PER YEAR WHEN CREAM IS SOLD ON BUTTERFAT BASIS

Select the average pounds of butterfat actually produced per cow per year, and the average price per pound for butterfat anticipated over a period of years, and follow the columns to the figure where they meet to determine the gross butterfat income per cow per year. Add the average calf income per cow (see note at bottom of table) and carry the total gross income figure to Table III.

Price per lb. received for butterfat	AVERAGE POUNDS OF BUTTERFAT PRODUCED PER COW OF MILKING AGE PER YEAR (*Select the nearest figure*)										
	200	*250*	*300*	*350*	*400*	*450*	*500*	*550*	*600*	*700*	*800*
15c	$30.00	$37.50	$45.00	$52.50	$60.00	$67.50	$75.00	$82.50	$90.00	$105.00	$120.00
20c	40.00	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	140.00	160.00
25c	50.00	62.50	75.00	87.50	100.00	112.50	125.00	137.50	150.00	175.00	200.00
30c	60.00	75.00	90.00	105.00	120.00	135.00	150.00	165.00	180.00	210.00	240.00
35c	70.00	87.50	105.00	122.50	140.00	157.50	175.00	192.50	210.00	245.00	280.00
40c	80.00	100.00	120.00	140.00	160.00	180.00	200.00	220.00	240.00	280.00	320.00
45c	90.00	112.50	135.00	157.50	180.00	202.50	225.00	247.50	270.00	315.00	360.00
50c	100.00	125.00	150.00	175.00	200.00	225.00	250.00	275.00	300.00	350.00	400.00
55c	110.00	137.50	165.00	192.50	220.00	247.50	275.00	302.50	330.00	385.00	440.00
60c	120.00	150.00	180.00	210.00	240.00	270.00	300.00	330.00	360.00	420.00	480.00

Note: Add to the above calculated figure the average value of calves at one week of age per milk cow owned. For example, if 20 cows of milking age are owned, 10 calves are sold per year at $10.00 each, and 5 heifers worth $15.00 are kept, the average figure would be
When breeding stock are regularly sold, add the average yearly 10 x 10=100
income per cow owned less average purchases. 5 x 15= 75

Total 175
20 cows=$8.75 per cow

DAIRY CATTLE TABLE III

HOW TO CONVERT GROSS INCOME PER COW PER YEAR TO RENT EACH COW AND HERD CAN PAY FOR NEW BUILDINGS

Bring forward from Tables I and II the amounts of gross income per cow per year. Follow down the column to the figure showing the yearly rent the cow can pay. Next below is the amount that can be spent per cow for all necessary buildings, and the total amount that normally should not be exceeded for varying sizes of herds.

	AVERAGE GROSS INCOME PER COW PER YEAR															
	$ 50	*$ 75*	*$ 100*	*$ 125*	*$ 150*	*$ 175*	*$ 200*	*$ 250*	*$ 300*	*$ 350*	*$ 400*	*$ 450*	*$ 500*	*$ 550*	*$ 600*	*$ 650*
Amount of rent one cow can pay per year @ 10% of income.	$ 5.00	$ 7.50	$10.00	$12.50	$15.00	$17.50	$20.00	$25.00	$30.00	$35.00	$40.00	$45.00	$50.00	$55.00	$60.00	$65.00
Amount each cow can pay for her share of all necessary buildings. (Basis 8% per year for cost of owning and maintaining buildings.)	62.50	93.75	125.00	156.25	187.50	218.75	250.00	312.50	375.00	437.50	500.00	562.50	625.00	687.50	750.00	812.50
Total Amount for herd of cows																
10 cows	625	938	1250	1563	1875	2188	2500	3125	3750	4375	5000	5625	6250	6875	7500	8125
20 cows	1250	1875	2500	3125	3750	4375	5000	6250	7500	8750	10000	11250	12500	13750	15000	16250
30 cows	1875	2813	3750	4688	5625	6563	7500	9375	11250	13125	15000	16875	18750	20625	22500	24375
40 cows	2500	3750	5000	6250	7500	8750	10000	12500	15000	17500	20000	22500	25000	27500	30000	32500
50 cows	3125	4688	6250	7813	9375	10938	12500	15625	18750	21875	25000	28125	31250	34375	37500	40625
60 cows	3750	5625	7500	9375	11250	13125	15000	18750	22500	26250	30000	33750	37500	41250	45000	48750

Hogs

The usual basis for determining the income from brood stock is to value the product as it is normally sold, such as eggs, milk, or when the young leave the dams. The values of these products from beef cows and ewes are easy to determine, but pigs are seldom sold at weaning; hence an arbitrary value must be placed on them at that time.

In using the tables which follow, the farmer should select the columns which best reflect the number of pigs he *sells* per year, per brood sow kept, and then estimate their value at weaning time. The usual ranges are covered in Table No. I.

Experienced hog raisers, farm managers, and accountants have found that only about 6 per cent of the gross income from the sow, when she is credited with the value of pigs at weaning time, should be spent for the annual use of buildings.

Table No. II shows the annual rent the sow can pay based on varying amounts of income, and the amount that can be spent per sow for the building she and the pigs will need, up to weaning, throughout the year. It does not include the shelters or other facilities for the pigs and hogs after weaning.

HOG TABLE I

HOW TO DETERMINE THE VALUE OF PIGS SOLD PER SOW PER YEAR

Select the actual average number of pigs weaned per sow per year (including both litters) and the average value of one pig at weaning and follow the columns to where they meet, to determine the value of pigs sold per sow per year. Carry figures to Table II.

Ave. Value of one pig at weaning	NUMBER OF PIGS WEANED PER BROOD SOW KEPT PER YEAR											
	5	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
$2.00	$10.00	$12.00	$14.00	$16.00	$18.00	$20.00	$22.00	$24.00	$26.00	$28.00	$30.00	$32.00
2.50	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50	40.00
3.00	15.00	18.00	21.00	24.00	27.00	30.00	33.00	36.00	39.00	42.00	45.00	48.00
3.50	17.50	21.00	24.50	28.00	31.50	35.00	38.50	42.00	45.50	49.00	52.50	56.00
4.00	20.00	24.00	28.00	32.00	36.00	40.00	44.00	48.00	52.00	56.00	60.00	64.00
4.50	22.50	27.00	31.50	36.00	40.50	45.00	49.50	54.00	58.50	63.00	67.50	72.00
5.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00
6.00	30.00	36.00	42.00	48.00	54.00	60.00	66.00	72.00	78.00	84.00	90.00	96.00
7.00	35.00	42.00	49.00	56.00	63.00	70.00	77.00	84.00	91.00	98.00	105.00	112.00
8.00	40.00	48.00	56.00	64.00	72.00	80.00	88.00	96.00	104.00	112.00	120.00	128.00

Many forest owners have cut and protected their properties so as to maintain a continuous forest growth for many years.

America has a permanent lumber supply. Timber is a crop — a renewable resource — and West Coast forests are being renewed.

HOG TABLE II

HOW TO CONVERT GROSS INCOME PER SOW PER YEAR TO RENT AND COST OF BUILDINGS

Bring forward from Table I the value of pigs sold per sow per year. Down the column from that figure note the yearly rent per year per sow. Next below, note the amount the owner can profitably spend per sow for all necessary buildings, and finally the total amount that normally should not be exceeded for varying sizes of herds.

	VALUE OF PIGS SOLD PER SOW PER YEAR (*Select nearest figure*)											
	$10.00	*$15.00*	*$20.00*	*$25.00*	*$30.00*	*$35.00*	*$40.00*	*$50.00*	*$60.00*	*$70.00*	*$80.00*	*$90.00*	*$100.00*
Amount of rent one sow can pay per year @ 6% of income	.60	.90	1.20	1.50	1.80	2.10	2.40	3.00	3.60	4.20	4.80	5.40	6.00
Amount each sow can pay for her share of all necessary buildings. (Basis 9% per year for cost of owning and maintaining buildings.)	6.67	10.00	13.33	16.67	20.00	23.33	26.67	33.33	40.00	46.67	53.33	60.00	66.67
Amount for varying sizes of herds of brood sows.													
10 sows	67	100	133	167	200	233	267	333	400	467	533	600	667
25 sows	167	250	333	417	500	583	667	833	1,000	1,167	1,333	1,500	1,667
30 sows	201	300	399	501	600	699	801	999	1,200	1,401	1,599	1,800	2,001
50 sows	335	500	665	835	1,000	1,165	1,335	1,665	2,000	2,335	2,665	3,000	3,335

Poultry

Poultry operations are becoming increasingly specialized. Hatching, raising, broiler production, and laying hens are now considered separate undertakings. The figures used here relate to the production of poultry on the farm where the maintenance of a laying flock is the chief objective. Most farmers buy baby chicks, raise them on the range until the cockerels are salable as broilers, and the pullets are ready for the laying house.

It is probably true that egg production per hen varies as much as any agricultural production. It goes back to the great range of conditions under which hens are kept, varying from tree top roosts to modern houses and from the best of feeding to almost none.

The following tables give the amount of money that can be spent for housing the laying flock.

POULTRY TABLE I

HOW TO DETERMINE THE GROSS VALUE OF EGG PRODUCTION PER HEN

Select the figure at the top of the column that most nearly represents the average number of eggs per hen per year. Follow down the column until you cross the line of average price of eggs per dozen. That figure is the value of production per hen to be carried forward to Table II.

Price of eggs Per dozen	NUMBER OF EGGS PRODUCED PER HEN PER YEAR								
	50	*75*	*100*	*125*	*150*	*175*	*200*	*225*	*250*
$.10	.42	.62	.83	1.04	1.25	1.46	1.67	1.87	2.08
.12	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
.15	.63	.94	1.25	1.56	1.88	2.19	2.50	2.81	3.13
.20	.83	1.25	1.67	2.08	2.50	2.92	3.33	3.75	4.17
.25	1.04	1.56	2.08	2.60	3.12	3.65	4.17	4.69	5.21
.30	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25
.35	1.46	2.19	2.92	3.65	4.37	5.10	5.83	6.56	7.29
.40	1.67	2.50	3.33	4.17	5.00	5.83	6.67	7.50	8.33
.45	1.88	2.81	3.75	4.69	5.63	6.56	7.50	8.44	9.38
.50	2.08	3.12	4.17	5.21	6.25	7.29	8.33	9.37	10.42
.60	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50
.70	2.91	4.37	5.83	7.35	8.75	10.15	11.66	13.12	14.70

For over 300 years most of the homes and farm buildings in America have been built of wood, so there is certainty in investment and there is no experiment when one builds with wood.

Wood as a building material combines low construction cost, structural strength, long life, and high insulating qualities, all of which are necessary to good farm building construction.

Lumber items are almost universally available. Most of these wood products require no special processing for immediate installation.

POULTRY TABLE II

HOW TO DETERMINE THE RENT EACH HEN CAN PAY PER YEAR AND THE AMOUNT THE FLOCK CAN PAY FOR NEW BUILDINGS

Bring forward from Table I the value of eggs produced per hen. Use the nearest figure at the top of the column. Follow down the column to the first line which shows the annual rent a hen can pay for the use of buildings. The next line below shows the amount the owner can profitably spend per hen for all necessary buildings and finally the total amount that normally should not be exceeded for varying sizes of flocks.

	VALUE OF EGGS PRODUCED PER YEAR PER HEN (*Select nearest figure*)										
	$ .50	*$ 1.00*	*$ 1.50*	*$ 2.00*	*$ 2.50*	*$ 3.00*	*$ 3.50*	*$ 4.00*	*$ 5.00*	*$ 7.00*	*$ 10.00*
Amount of rent one hen can pay per year @ 9% of income	.05	.09	.14	.18	.23	.27	.32	.36	.45	.63	.90
Amount each hen can pay for her share of all necessary buildings. (Basis 9% per year for cost of owning and maintaining buildings.)	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	5.00	7.00	10.00
Amount for varying sizes of flocks											
50 hens	25	50	75	100	125	150	175	200	250	350	500
100 hens	50	100	150	200	250	300	350	400	500	700	1000
200 hens	100	200	300	400	500	600	700	800	1000	1400	2000
300 hens	150	300	450	600	750	900	1050	1200	1500	2100	3000
500 hens	250	500	750	1000	1250	1500	1750	2000	2500	3500	5000

Sheep

There are two sources of annual income from sheep—lambs and wool. Both contribute to the income from which the funds must come for construction of sheep shelter.

The major sheep producing areas are in the Western parts of the United States where sheep are range raised and where few buildings are used. Frequently mid-west operators feel that they need large, warm barns for their flocks. It is protection against cold rains and freezing temperatures rather than excessive cold that is important. Of course, new born lambs cannot survive extremely low temperatures; hence, those who specialize in winter lamb production must furnish adequate protection.

The tables which follow provide a quick and easy means for calculating gross income per ewe. About 7% of income can be devoted to building facilities for the flock.

SHEEP TABLE I

POUNDS OF LAMBS PER EWE PER YEAR

Select per cent of lamb crop and weight of lambs when sold and follow the columns to where they meet to determine the pounds of lambs produced per ewe per year. Carry figure to Table II.

Per cent of Lamb Crop	AVERAGE WEIGHT OF LAMBS AT SELLING TIME—IN POUNDS							
	40	*50*	*60*	*70*	*80*	*90*	*100*	*120*
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
50%	20	25	30	35	40	45	50	60
60	24	30	36	42	48	54	60	72
70	28	35	42	49	56	63	70	84
80	32	40	48	56	64	72	80	96
90	36	45	54	63	72	81	90	108
100	40	50	60	70	80	90	100	120
110	44	55	66	77	88	99	110	132
120	48	60	72	84	96	108	120	144

SHEEP TABLE II

HOW TO DETERMINE THE GROSS INCOME PER EWE PER YEAR

Select the nearest weight of lambs produced and average price received for the lambs. Follow these columns to where they meet to determine gross income per ewe per year. Take this figure forward to Table III after adding the value of the wool. (See note below.)

Price of lambs per pound	AVERAGE WEIGHT OF LAMBS PRODUCED PER EWE PER YEAR										
	20 lb.	*30 lb.*	*40 lb.*	*50 lb.*	*60 lb.*	*70 lb.*	*80 lb.*	*90 lb.*	*100 lb.*	*120 lb.*	*140 lb.*
$ .05	$ 1.00	$ 1.50	$ 2.00	$ 2.50	$ 3.00	$ 3.50	$ 4.00	$ 4.50	$ 5.00	$ 6.00	$ 7.00
.07	1.40	2.10	2.80	3.50	4.20	4.90	5.60	6.30	7.00	8.40	9.80
.09	1.80	2.70	3.60	4.50	5.40	6.30	7.20	8.10	9.00	10.80	12.60
.10	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	12.00	14.00
.12	2.40	3.60	4.80	6.00	7.20	8.40	9.60	10.80	12.00	14.40	16.80
.15	3.00	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15.00	18.00	21.00
.17	3.40	5.10	6.80	8.50	10.20	11.90	13.60	15.30	17.00	20.40	23.80
.20	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	24.00	28.00
.25	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	30.00	35.00

Note: The value of the wool is calculated by using average long-time prices and the average wool sheared per ewe in the flock. Add this to the value of the lamb, thus:

Average value of lamb from this table:	$7.00
Shear per ewe—8 lbs. wool @ 25c	2.00
Take this total to Table III:	$9.00

SHEEP TABLE III

HOW TO FIND THE RENT EACH EWE CAN PAY AND AMOUNT TO BE SPENT FOR BUILDINGS

Bring forward from Table II the amount of gross income per ewe per year. Follow down the column from that figure and note the yearly rent each ewe can pay. On the next line below in the same column is the amount each ewe can pay for her share of the new building. The next figures below show the total amount that normally should not be exceeded for varying sizes of flocks.

	VALUE OF LAMBS AND WOOL PER YEAR (*Select nearest figure*)									
	$ 3.00	*$ 5.00*	*$ 7.00*	*$ 10.00*	*$ 12.00*	*$ 15.00*	*$ 18.00*	*$ 20.00*	*$ 23.00*	*$ 25.00*	*$ 30.00*
Amount of rent one ewe can pay per year @ 7% of income	.21	.35	.49	.70	.84	1.05	1.26	1.40	1.61	1.75	2.10
Amount each ewe can pay for her share of all necessary buildings. (Basis 8% per year for cost of owning and maintaining buildings.)	2.63	4.38	6.13	8.75	10.50	13.13	15.75	17.50	20.13	21.88	26.25
Amount for varying sizes of flocks											
25	$ 66	$ 110	$ 153	$ 219	$ 263	$ 328	$ 394	$ 438	$ 503	$ 547	$ 656
50	132	219	307	438	525	657	788	875	1007	1094	1313
100	263	438	613	875	1050	1313	1575	1750	2013	2188	2625
125	329	548	766	1094	1313	1641	1969	2188	2516	2735	3281
150	395	657	920	1313	1575	1970	2363	2625	3020	3282	3938

CHAPTER 4

NEW IDEAS IN FARM BUILDINGS

Many new ways of handling livestock and crops are being advocated. It is not always a good policy to jump in and try every new idea that comes along. Some of them involve large capital expenditures. It is wise to first see how the new method has worked for others who have tried it. The advice contained in this chapter is based on the experience and observation of practical farm managers who regularly travel wide areas involving many states. They have the opportunity of seeing new ideas tried under many different conditions and observing both the good and objectionable features.

The following suggestions regarding new ideas in farm buildings are based upon the most practical money-making methods known today.

Loafing Sheds for Dairy Cows

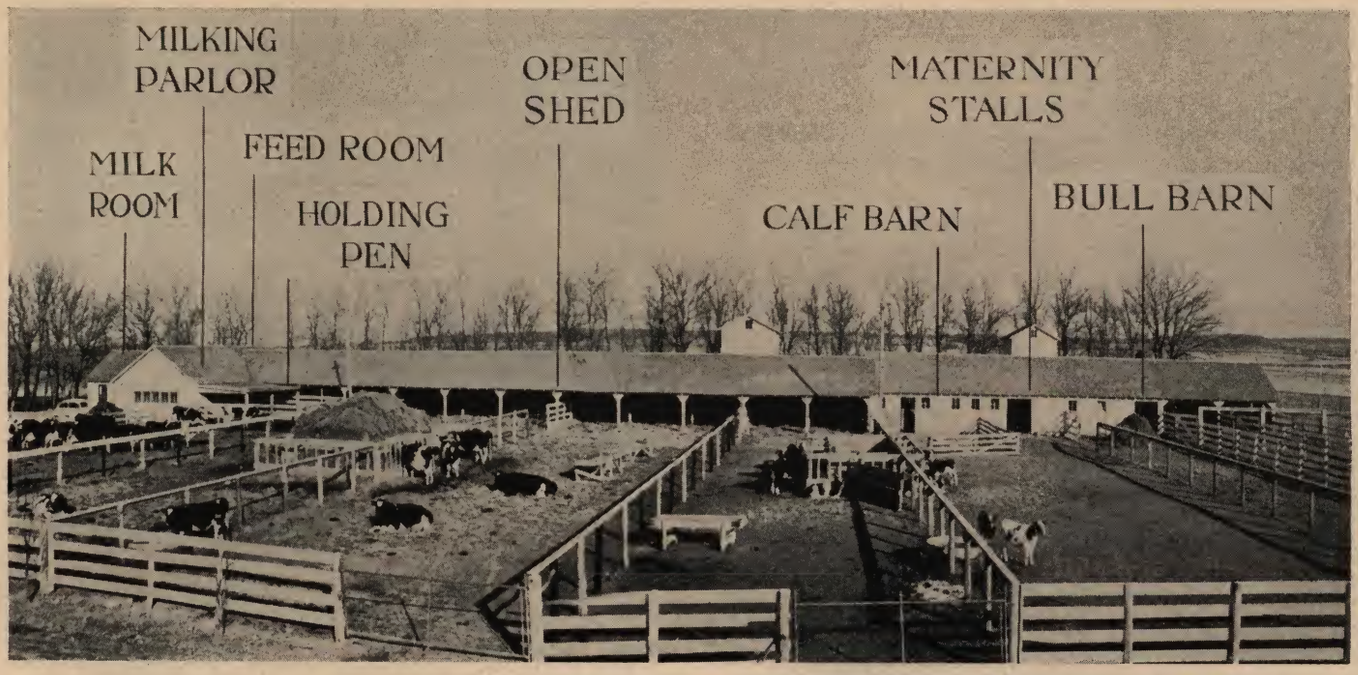
A progressive young farmer commented, "My experience as a boy will always remain with me. I well remember the job of milking cows. It seems that the cow I was to milk always had her tail in the gutter, and she took particular delight in wrapping her wet tail around my neck. If she didn't get me, the cow to my back did. The only protection I had was to pull my hat down over my ears, stick my head up against the cow's flank, and go after the milk. At that time, of course, I thought that was one of the necessary evils of having a dairy herd. You can well realize that there wasn't any selling job to be done when I first heard of the loafing barn and milking room which took the cows out of the stanchions, their tails out of the gutter, and provided a clean place for milking."

This is typical of the experiences on many farms. Loafing barns have become well founded but *one of the greatest advancements* is the use of merely a low-cost open loafing shed. Actual experience has shown that there is very little, if any, difference in milk production between housing in stanchion barns and open sheds. A two-year test conducted by the University of Wyoming shows:

Type of Building	*Average Daily Milk Production*	*Average Daily Butterfat Production*	*Average Daily Feed Cost per cow*
Open Shed	29 lbs.	.975 lbs.	$.168
Modern Barn	27 lbs.	.889 lbs.	$.155

A loafing arrangement is adaptable to most areas except where there is a critical shortage of bedding or where a purebred herd is kept and the removal of horns is objectionable. It is often possible, however, to make a special

"Wood has stood the test of time as a building material. On every hand one finds proof of the permanence that is obtained when wood construction is properly used." U.S.D.A. Farmers' Bulletin No. 1756.



Courtesy Agricultural Development Department, Union Pacific Railroad Company

A Modern and Efficient Dairy Unit with Milking Room.

effort to produce bedding or purchase it, and there is some movement toward doing away with placing value on horns in purebred judging.

Advantages of Loafing Sheds and Pen Barns

1. *Lower construction costs*—no stanchions. The shed type building is entirely satisfactory.
2. *Cows are kept cleaner*—udders and tails are never exposed to gutters.
3. *Cleaner milk is produced*—cows' udders are cleaner.
4. *Less labor required*—especially in feeding, manure removal, and milking. After installing a loafing barn a dairyman stated, "We usually have about 20 or more milking cows and heifers, several brood sows with their litters, raise 1,000 chicks and keep 225 layers and have four horses. I can truthfully say that since I have had my pen-type barn I can do these same chores alone nearly as quickly as two of us did them before because there are no stables to clean daily and I can easily milk two cows in the milking room as quickly as one in a stanchion." (Michigan State College, Bulletin 195.)
5. *Animals have greater comfort*—not confined to stanchions.
6. *Fewer injuries to cows*—warm bedding acts as a cushion, less udder injury, fewer cases of mastitis, no crowding, and no stanchion knee injuries.
7. *Larger amount and high quality of manure is produced*—the straw absorbs larger amounts of the liquid manure, there is little loss of nitrogen by bacterial action, and the manure can be spread on the fields before it deteriorates. (The quantity of manure can be doubled by liberal use of straw. For a 20-cow herd this may mean additional income ranging from $300.00 to $500.00 a year in the form of increased bushels of corn, tons of hay, and higher yields of other crops.)
8. *Manure is easily and quickly removed*—power loading equipment can be used in the loafing area.
9. *Daily removal of manure is eliminated*—it can be

Courtesy Michigan State College

Cows are Comfortable in a Pen Barn.

Courtesy Michigan State College

Cows Remain Clean in a Pen Barn.

removed when time is most convenient and fields are satisfactory for spreading.

10. *The herd can be increased without major changes*—no additional equipment needed.
11. *The barn is easily adapted to other kinds of livestock*—no stanchions and feed mangers to remove.

Disadvantages of loafing sheds and pen barns are:

1. *Normally require twice as much bedding*—require 1½ to 2 tons per cow.
2. *"Boss" cows cause trouble*—almost every herd has one or more cows that try to keep the others away from the feed mangers.
3. *Cows must be dehorned*—it is not practical to attempt the loafing arrangement without dehorning.
4. *The loafing barn requires more space per cow for 20 cows or less*—mainly because a special place must be provided for calves, and the milking room will need to be just as large for a herd under 20 cows as for herds up to 30 and even 40 head.
5. *It is sometimes difficult to arrange the barn for separate handling of calves and young stock*—a certain portion needs to be penned off for maternity and calf quarters.

Disadvantages can often be overcome

Where straw is plentiful the farm can be made a "fertilizer factory." It often pays to purchase bedding or make a special effort to harvest poor quality hay, soybean straw, corn fodder, or other roughage.

The "boss" cows can usually be controlled, or difficulty minimized by using partition feed mangers and feed bunks as shown in Chapter 5.

Dairy cattle should really be dehorned anyway to eliminate injury while they are in lots and pasture, as well as when in loafing barns and sheds.

The requirement for more space per cow for small herds need not hold where a dry outside lot is provided.

The problem of arranging space for calves and young stock should not be such a problem when one considers the importance of having separate maternity and calf quarters for every setup.

Milking Rooms and Milk Houses

Milking Rooms

In Ohio a 68-year-old man handles 40 cows "easier than handling 15 to 20 the old way." He puts them through his two-cow milking room at the rate of one every three minutes. In Nebraska, one man with a four-cow tandem milking room milks thirty cows an hour.

It takes less money to construct a sanitary and efficient milking room than to build a large stanchion dairy barn. The combination of an efficient milking room with low-cost loafing sheds is now a proved idea. The system is not as yet in general practice mainly because the method is so different from former methods.

There are several types of milking rooms that are quite satisfactory. The most common is similar to a good stanchion barn; four, six, eight, or even twelve cows are handled at a time. One satisfactory arrangement has the feed manger constructed on a door that allows the cow to walk through the stall and out into the loafing area.

A new type of milking room now in use makes it possible to milk cows conveniently. It is a pit-type room so arranged that the man works within the pit and the cows come to him rather than lugging equipment to and from

Courtesy Michigan State College

A small milking room with three stalls abreast. Similar milking rooms with four stalls are more popular. Note the "walk-through" doors.

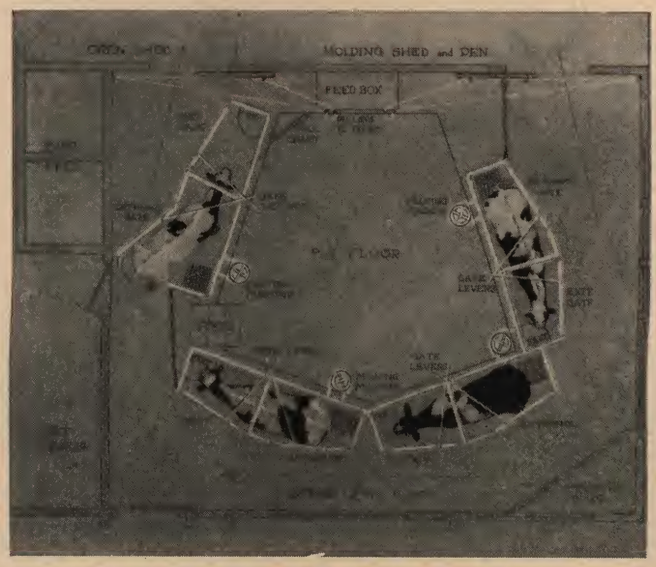
them. Some users think it is not only faster but makes the job of milking much easier.

The Ohio two-cow milking room is of this type and consists of a pit where the cows come in on both sides of the man, six feet apart. The feed bunk for each cow is constructed on a track and can be pulled out over the pit so the cow can walk out, and at the same time more grain can be put in the bunk. The cows are milked with a two-unit machine. A bucket of chlorine solution is placed next to the milker on each side. The teat cups are dipped in the solution and hung to drip while the cow just milked is walking out and another walking in.

This system of milking is one of the most efficiently designed as far as saving the man is concerned. The system worked out in Nebraska is somewhat similar. It consists of handling four cows and permits faster milking because the next cow to be milked can be prepared in advance so that there is no loss of time with the milking machine. After establishing a routine, thirty cows an hour can be milked by one man.

Advantages of Milking Rooms

1. *Lower building cost* in meeting milk ordinance requirements. It takes considerably less money to



Courtesy Agricultural Development Department, Union Pacific Railroad Company

Low-cost Efficient Milking Room Plan.

build a small well-constructed unit through which a large number of cows can be handled than to construct the whole barn so it will fulfill sanitary requirements.

2. *Faster milking* can be accomplished when the milking room is efficiently arranged so the cows spend their time coming to the man rather than his going to the cows.
3. *Cleaner milk* is produced. It is easier to keep a small area thoroughly cleaned than to keep an entire barn clean enough for the milking area.
4. *Larger volume* is handled. Lower building cost leaves more money for additional cows and faster, easier milking makes it possible for one man to handle more cows.

Disadvantages of Milking Rooms

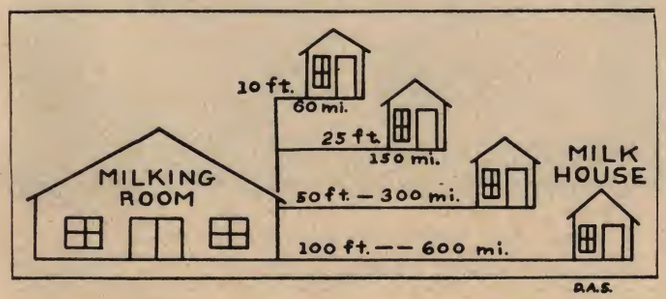
1. *Supplemental heat is needed* during cold weather in northern climates. This can be quite easily supplied with small stoves or oil burners to take off the chill.
2. *Occasionally cows will not come into the milking room* on their own accord. This does not cause trouble except when cows are on good grass during the spring. Most of the year they are eager to eat their grain and will wait their turn to come into the milking room.
3. *Sometimes it is hard to find an experienced person* to take over if operator becomes sick or must be away for a few days.

Milk House

New thinking has gone into milk house requirements. At one time it was necessary to place the milk house at rather long distances from the milking room or dairy barn. Now the reverse is true. New milk houses should be attached to the milking room or barn, and in most cases city ordinances will permit construction under the same roof when a passageway with two doors is provided between the milking room and the milk cooling and utensil room. This is a big advancement and makes it possible to coordinate feeding, caring for the cows, milking them, and handling the milk, all into an efficient system.

Local sanitary requirements should always be checked before constructing or remodeling a milk house. If there are no conflicts the house should include these main features:

1. *Location*—It should be built adjacent to the milking room to save as many steps as possible. A vestibule between the two 4 feet wide and 4 to 6 feet long with both self-closing doors opening toward the milking room, will meet most requirements.



Information from Cornell University

Build the milk house within the milking room or adjacent to it, and save miles of walking each year.

2. *Interior Arrangement*—Cooling equipment should be close to the entrance from the milking room in order to save steps when emptying each pail of milk.
3. *Refrigeration*—Higher quality milk standards will be continually demanded. This makes it more and more important to have electric refrigeration within the milk house. The most practical kind of refrigeration has been the water tank type. *Dry box* and walk-in type coolers are being used with considerable success. It is necessary to first thoroughly cool the milk before or as it is being placed in the dry box cooler. Early experiments with this type of box indicated high operating costs. Later tests now show that operating costs can be about the same as the water tank type cooler.

Dry box refrigeration has several advantages. Lifting of heavy cans in and out of deep tanks is reduced in certain types where the milk is strained, immediately cooled over an aerator, and run directly into the can within the dry box. This also eliminates the necessity for mechanical agitation, and reduces chances for contamination. All of this helps maintain a low bacterial count.

Electric water tank coolers are less costly and meet most city ordinance requirements for Grade A milk. Home-made tanks are somewhat difficult to properly insulate. When constructed, the insulation should be 4 inches thick. If a commercial unit is to be used the milk house door should be 2′8″ wide to admit it into the building. Tanks should be recessed so the top is 12 inches above the milk house floor. There are many backaches in lifting cans up several feet and too much strain if the tank is lower than 12 inches.

SIZE OF MILK COOLING TANKS, OUTSIDE DIMENSIONS*

Capacity	Concrete Insulated
Number of 10 Gallon Cans	*Inches*
2	41 x 62
3	41 x 84
4	59 x 66
6	59 x 88
8	59 x 110
10	59 x 134
12	59 x 158

From Cornell University

*These sizes are based on cooling only night's milk and are such that there will be three canfuls of water in the tank for each can of milk being cooled.

Photograph courtesy the New York State College of Agriculture

A commercial insulated tank in a pit. The wall prevents dirt from getting into the pit and a drain at the bottom permits flushing. Sufficient space should be left between the pit wall and the tank to insert a broom for cleaning.

The size of pit should be determined by the exact size of the commercial unit to be used. The home-made cooling tank without a water circulator should provide three times as much water in the tank as there is milk being cooled. This will mean a tank floor area of 450 sq. inches per can.

4. *Insulation*—The milk house should be insulated so it will not become excessively hot in the summer and so the milk will not freeze in the winter. When the milk house is connected to the milking room, one small heater can be used for both. A frost-proof water hydrant will reduce the requirement for winter heat.
5. *Ventilation*—The milk house should have a louver in the gables and an adjustable sliding door opening in the ceiling or a roof ventilator. Ventilators 12 to 20 inches in diameter are of sufficient size for most houses.
6. *Drainage*—The floor drain should be under the wash-sink and against the wall. A large capacity floor sink-type drain approximately 12 inches in diameter is convenient for emptying pails and cans of water. The floor should slope ¼ inch per foot to the drain.
7. *Size*—Most milk houses are constructed too small. When a new house is built, allow room for expansion. Cornell University, in Bulletin 330, recommends the following sizes of milk houses.

RECOMMENDED SIZES FOR MILK HOUSE ATTACHED TO THE BARN

Cans of milk per day	Size	Square feet per can
Number	*Feet*	
2	8 x 8	32
4	8 x 10	20
6	10 x 10	17
8	10 x 12	15
10	12 x 12	14
12	12 x 12	12
16	12 x 14	11

From Cornell University

RECOMMENDED SIZES FOR MILK HOUSES SEPARATE FROM THE BARN*

Cans of milk per day	Size	Square feet per can
Number	*Feet*	
2	6 x 8	24
4	8 x 10	20
6	10 x 10	17
8	10 x 10	13
10	10 x 12	12
12	10 x 12	10
16	12 x 12	9

From Cornell University

*These should be considered minimum rather than maximum recommended sizes.

SINGLE-STORY AND MULTIPLE-STORY POULTRY LAYING HOUSES

One of the most controversial issues on types of structures is that of single-story versus multiple-story poultry houses. There is a wide variety of *opinions* on the subject but very few *facts* to determine which type of structure is the most economical and profitable to use. It should be recognized that multiple-story poultry houses are not well adapted

Courtesy University of Minnesota

A Modern Two-Story Poultry House.

to small flocks. It is estimated that over 90 per cent of all egg production comes from flocks under 500 hens.

For larger flocks the question is which type of house will cost less to construct? Which type of house will require fewer man hours per 1,000 birds handled? The true answers to these questions are not available. Some large poultry producers have used, and are using, both single-story and multiple-story laying houses. Some are very emphatic that they would never again build a multiple-story poultry house.

Other poultry men are just as emphatic that they would never again construct a single-story poultry house. One has stated: "There is no question in my mind but that the labor requirement per 1,000 birds is much less in a well designed two-story unit than in a single story. It is warmer. It is more compact. The maintenance cost is less. When properly designed it is more economical from every standpoint than a one-story structure, and is preferred by the men taking care of the birds. Of course, design, layout, etc., do enter the picture and are important factors." It is possible that the method of handling the work in the one-story structure has not been standardized to eliminate unnecessary walking, movement of feed, eggs and litter, and removal of manure.

All of this brings the subject down to the fact that *farm*

A Practical House For Small Flocks.

Lumber can be used again and again; this is important on the farm where buildings are to be moved to new locations or remodeled for additional space and convenience.

buildings should be constructed to carry out a standardized method of production. With a proper system of accomplishing the work involved, it is entirely possible for both the one-story and two-story poultry houses to be quite efficient. For small flocks, single-story structures are to be preferred. Except for unusual conditions, multiple-story laying houses should not be given serious consideration unless the flock is larger than approximately 4,000 birds.

Some of the most important points to consider in deciding between a single-story and a multiple-story structure are as follows:

1. *Cost*—Normally, cost per bird is less for the multiple-story house than for the single-story structure where the capacity is approximately 4,000 birds or more. This is because the cost of only one foundation and one roof is divided between two or more floors. It should not be overlooked that multiple-story structures require a *higher quality* of workmanship as well as material. Foundation, framing, and bracing, all must be heavier. Man and feed elevators are desirable yet costly, often slow, and sometimes dangerous.
2. *Labor*—Labor requirements can be simplified and work routine well planned for both single and multiple-story structures. For flocks under approximately 4,000 birds, it will usually take less labor for the single-story house.
3. *Feed*—The single-story unit has the advantage of moving feed laterally rather than vertically. A track and carrier will move large quantities of feed horizontally without power equipment, whereas it is necessary to have power elevating equipment for multiple-story structures. Once the feed is elevated, then the multiple-story has the advantage of gravity to carry the feed to each floor.
4. *Eggs*—The gathering of eggs in single-story structures can be simplified by the use of a track and carrier. Feed can be taken one way on the carrier and eggs carried on the return trip. Where this system is used, there is an apparent saving of time in gathering eggs in the single structure. Multiple-stories involve the movement of the eggs laterally to the stair or elevator and then down to the storage room.
5. *Litter*—The storage and movement of litter is more of a problem in the multiple-story house. It must be carried, elevated, or hoisted one or several stories high. A single-story unit involves simple storage on the ground floor and lateral transportation on the track and carrier.
6. *Manure*—The removal of manure has been a greater problem in the single structure. It is now simplified by the use of large drive-through doors which enable one to bring the spreader through the middle of the house so there is actually very little lateral movement to place the manure directly into the spreader. By using deep built-up litter, cleaning of houses can be reduced to once or twice a year, so that the drive-through principle is not objectionable. Multiple-story structures can be cleaned by simply pushing the litter to a chute where it can fall directly into the spreader. If the deep built-up litter system is used there will be some difficulty in sliding large quantities.
7. *Water*—It is easier to keep water pipes from freezing in single-story structures. Water can be piped underground and up to a water fountain with very little pipe exposure. Electrical soil heating cable can be wrapped around water pipes going to second and third floors which somewhat nullifies this disadvantage although it means added cost.

PORTABLE COLONY HOG HOUSES

Hog raisers have been saying, "If all of the good points of the central farrowing house could be combined with the merits of the individual hog house, it would make an ideal building for hogs." Now we have that building—a two-section portable hog house that combines the features of the central and individual house, plus additional features that are not found in either of the other two structures.

A portable 4-sow colony hog house with both sections pulled together for winter use. A main door to the center alley is on the opposite side. A house 20′ long and accommodating 6 sows is preferred by some operators, although it is somewhat heavy to move over rolling topography.

(D.A.S. Photo)

As spring advances the sections can be gradually moved apart so the hogs will have an abundance of fresh air.

The first and foremost factor to consider in making money with hogs is *sanitation.* When a program of sanitation and timely marketing is followed, hogs are one of our most profitable animals. The reason a sound program returns such good dividends is that relatively few farmers have the equipment to carry out a *complete* sanitary program and farrow pigs early for marketing at highest prices in March and September.

The central farrowing houses provide accommodations for early spring or late winter farrowing but they are too hot for summer and fall farrowing and, worst of all, they invite the use of disease contaminated lots. On the other hand, the small individual house is too cold for winter farrowing in northern climates, and unless the sides open

Construction methods for wood structures are so thoroughly understood that builders know in advance every detail of the structural behavior of the lumber materials going into the building.

out, the house is too hot for summer farrowing. Furthermore, neither type of structure gives adequate shade during hot summer months. All of these necessities are provided with the two-section portable colony hog house. Here is how this building is used twelve months out of the year:

1. *Winter Shelter*—During the cold winter months, the two sections are pulled together for either brood sows or fattening hogs. The ridge is left open several inches which provides good ventilation.
2. *Easy to Clean*—Removable floors simplify the job of thoroughly cleaning the house compared to the back-breaking task of getting into the small crowded quarters of an individual house.
3. *Winter Farrowing Quarters*—After the house is thoroughly cleaned and disinfected, it can be moved to clean ground for late winter and early spring farrowing. The houses are pulled together and panels can be used outside each pen so brood sows can be fed and locked outside while removing bedding, cutting tusks, or earmarking the pigs. The alleyway gives space so the attendant need not stand out in a blizzard while the sows are farrowing. A small heater can be placed in the alley during extremely cold weather, or two ordinary farm lanterns will do an excellent job of taking off the chill. The alley can also be used as an emergency farrowing pen, or a self-feeder can be placed in it and used as a creep for starting little pigs. Space over pens can be used for the storage of straw, buckets, and feed.
4. *Spring Shelter*—Just as soon as freezing weather is over in the spring, the houses are separated, facing the open side to the south. This gives an abundance of sunshine and fresh air within the house to help develop vigorous, healthy pigs.
5. *Summer Shade*—As the summer advances, the two sections can be pulled eight to ten feet apart so that the removable floors can be placed across the ridges. Blocks can be placed under the outside runners so that cool breezes from any direction can blow through the house.
6. *Summer Farrowing*—The floors are not needed for summer farrowing. It is an easy task to disinfect the walls and again move the sections to clean ground. This time, they are placed with the open side facing northeast. A block is placed under the outside or back runner so that air can flow in and through the farrowing quarters. Panels can be placed at the front of the pen.
7. *Fall Shelter*—Just as soon as the weather cools and shade is not essential, the sections are again turned facing south so that the hogs have the advantage of sunshine and fresh air, desirable for health and hearty development for winter.
8. *Twelve Months Use*—Before extremely cold weather sets in, the houses are pulled together to afford comfortable winter quarters. During the year, a portion of the houses are used for the brood sows and the remainder for the fattening hogs. The house is a labor-saver for it takes care of each job at the right time—no time wasted during the busy crop season for building shades. Because it does so many jobs during the year, the unit cost is low. It invites proper handling of hogs—a real money-maker.
9. *Small or Large Hog Enterprises*—The portable colony house is adaptable to both small and large hog enterprises. The man with one or two sows can farrow them in part of the house while the remaining part can be used to shelter fattening hogs.
10. *Other Uses*—The same two sections can be placed together at right angles to serve as a sheep shelter or used as lambing pens. They serve as excellent range shelter for poultry and turkeys or for calves on temporary pastures. This is a type of building that has flexibility, versatility, many uses, and low cost.

(D.A.S. Photo)

Units are separated and faced northeast for summer and early fall farrowing.

IMPROVED FARM MACHINE SHEDS AND SHOPS

Modern Equipment Needs Shelter

Tractor equipment is fast replacing horse-drawn tools. In addition to tractors, we now have combines, corn pickers, forage harvesters, one-man balers, four-row planters, grain and fertilizer drills, power sprayers and dusters, potato diggers and other mechanized equipment. They do considerably more work with their many moving parts than simple horse-drawn walking plows and double-shovel cultivators.

At one time there was not much loss when equipment was left out in the weather. Today, every good operator knows the loss that may occur when machine storage space is not available. Rusty chains, wheels, and shafts can cause a breakdown which may lose only a half-day's time; but rain, hail, floods and other storms at that critical time can mean a total loss of the crop involved. Thus, *machine sheds are needed for modern farming* not mainly to save equipment, but *to save crops.*

The man who left his four-row planter out all winter learned of the value of housing modern equipment the hard way. His rush to plant his corn, because of a late rainy season, caused him to overlook the rusty small planter box springs. When his corn came up, it was only half a stand and it was too late to replant. Yes, modern equipment does need shelter and it will pay for housing from dividends of increased crops grown and harvested.

"There are houses in this country that were built in Colonial Times, out of lumber and timbers locally available, and are still occupied and in good condition after 200 years, more or less." U. S. Forest Service, Forest Products Laboratory.

Machine Sheds Should Invite Use

Machinery left out in the yard half the season will not return dividends on a vacant shed. This building must be easy to use, otherwise the equipment will not be put away until there is a slack period. Other work at harvest time is more urgent than spending an hour or two pushing machinery into tight corners—that is why machinery is left standing out. The only way to make a shelter work full time is to make it just as easy to leave the equipment under the roof as to park it outside.

(D.A.S. Photo)

This machine shed and shop invites use. It is 50 feet long—20-foot shop and 30-foot truss-supported roof.

The pictures here illustrate one of the newest and most practical machine sheds built today. It completely gets away from standard design and deviates so much from the type that normally has been considered a machine shed that it may not appeal to some farm operators until they have given it considerable thought. The building is a combination shop and machine shed. The machine shed consists of only a roof supported by a 50-ft. truss leaving both sides and one end open. The design of these trusses should be on the basis of engineering principles and they should be built with stress-grade lumber.

In northern climates, it is important to locate this trussed machine shed so that the north and west are protected by other buildings or trees to break the force of driving snowstorms. When this is done, very little snow blows on the equipment. It is found that more rust and deterioration occur when equipment is left out most of the summer in heavy rains and hot sunshine, than when

This Illinois machine shed is protected by the shop on the north and other buildings and trees on the west and northwest. There is no problem in putting machinery under the 50-foot truss-supported roof—just like driving under a big shade tree.

A structure such as this, with space between two cribs, is an economical way of providing storage for machinery. It should have rolling "drive through" doors on the back.

equipment is kept under an open roof and becomes occasionally wet from small amounts of rain and snow.

Large Openings and Post-free Spans

Some operators prefer a completely enclosed machine shed and are willing to spend more time opening and closing doors and pay the extra cost and maintenance. Such structures should have three main features:

1. *Large door openings*—12 to 14 feet wide and 10 to 12 feet high.
2. *"Drive-through" doors*—Drive in one side and out the other—no backing of heavy and awkward equipment.
3. *Post-free spans*—so that equipment can be moved anywhere within the interior.

Shops for Modern Equipment

A good shop makes money. If it is heated it encourages equipment repair during winter months so that everything is ready to go at the break of spring. When breakdowns occur during the busy harvest season, a good shop often makes it possible to have the equipment humming in short order. The man who has wasted hours at a machine shop to get several holes bored in a piece of iron that could

This shop is 30′ x 32′ and is attached to an open 32′ x 50′ trussed machine shed. Although the shop was not equipped when the picture was taken, it does illustrate these good features: plenty of room to work on tractors and other equipment, good window lighting and overhead storage space.

have been done in a farm shop realizes the importance of having a place and tools for doing minor repair jobs.

Some of the main features of a good farm shop are listed as follows:

Location—On central court of farmstead. Between house and other buildings. Desirable to combine with machine shed but can be connected to garage or both. Open sheds are protected by other buildings or trees.

Construction—Should be entirely and tightly enclosed for winter warmth. Wood construction is usually most economical and satisfactory. Overhead support should be sufficiently strong to support hoist for tractor, butchering, and other heavy lifting.

Size—Large enough to get machine inside with sufficient room to work on it. 20′ x 20′ is highly satisfactory.

Floor—Concrete is usually most satisfactory and is easily kept clean. In some localities heavy plank floors may be more desirable for warmth and comfort.

Openings—Door for tractors and implements 12 feet wide. Door for operator's use 3½′ x 7′ (preferably both doors on same side). Row of windows full length on one side.

Heat—Stove or heater for winter work will increase the usefulness of shop.

Electricity—At least a 100-watt bulb for each 200 sq. ft. floor space. Wiring to all motor equipment. Two to four service outlets for extension lights, portable drills, saws, soldering iron, and other equipment.

Equipment—Bench full length on side with windows. Use two 2 x 12 planks for top and cover the portions where hammering and riveting will be done with one-fourth inch sheet steel 4 feet long. Extend top over edge 3 to 4″ to provide room for knees. Height about 3′3″. Shelves and doors below bench. Allow 4″ x 4″ toe space at bottom. Enclosed cupboard for tools needing best care. Hang other tools on pegs.

Courtesy Westinghouse Electric Corporation

The most important time-saving tool in the shop is a power emery wheel.

Tools for the Farm Shop—Many farm shops are quite well equipped with small tools but lack some of the larger equipment that would make it possible to handle major repair and construction jobs quickly and efficiently.

The most important kinds of farm shop equipment measured from the standpoint of what they will accomplish for the operator, are:

1. Power emery wheel
2. Portable Electric Drill
3. Thread Cutter Tap and Die Set
4. Welding Outfit
5. Power Hack Saw.

Welding equipment is recommended instead of a forge because it is more useful and easy to handle. With it one can cut metal, weld, braze and solder, and put a hard cutting edge on tools.

Some of the other items which make a well-equipped shop are as follows:

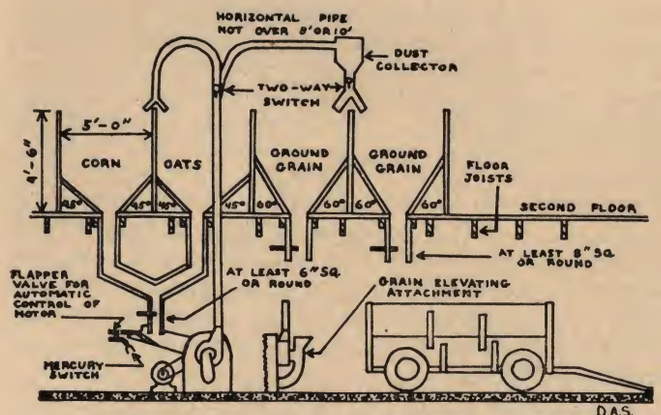
Anvil, 100 lbs.; bench screw or "C" clamp, 2; blow torch; brace and bits, ¼″, ⅜″, ½″, ⅝″, ¾″, ⅞″; extension bit 1½″; chisels, 2 wood, 3 iron; compass (dividers); drawing knife; drill bits, 12 from 3/32″ to 1″; files, 2 flat, 1 round, 2 triangular; grease gun; hammers, claw, sledge, ball peen; hatchet; hoisting block (¾″ rope or ½″ chain); jack screw, 10 ton; level; mallet; maul; oil cans (long and short spout, force feed); oil stone; pinch bar; pliers, 8″ combination, lineman's, and fencing; plane (jack); punches (set of six); putty knife; rasp; saws (crosscut, rip, compass, hack, power-bench or portable); screw drivers (3 assorted sizes); square (carpenter's steel); tape line (50′ steel); tape, six-foot steel; tinners' snips; soldering iron (electric); vise, 4″ or larger; wire splicer; wrenches, 8″ crescent, 12″ crescent, 15″ monkey, 14″ pipe, 6″ pipe, set of "S", set of sockets.

CENTRALIZED GRAIN STORAGE

Both grain and livestock farms can profit by having centralized grain storage. If the work of doing "chores" on such farms is analyzed it will be found to consist mainly of *moving grain and feed.* For example, when the hogs are fed it is often necessary to scoop on a load of corn and haul it to the feeding place, or feeding cattle may require

(D.A.S. Photo)

A grain feeding shed (cattle standing in doorway) and an open shed for additional shelter attached to the centralized grain storage building.



From Kansas State College Material

A good arrangement for handling feed at the centralized grain storage.

carrying many baskets of feed. This takes a great deal of time and often it is hard work.

Much work can be eliminated by centralized grain storage. The important features are:

1. *Kind of storage*—The structure should be designed to take care of all kinds of grain fed. It should handle ear corn as well as small grains so that the feed produced on the farm and that which is purchased can be quickly stored or taken from storage at one central point.
2. *Type of Structure*—The granary should be of rigid construction, yet versatile in design so that it will handle a wide variety of feed. For example, the corn crib can be lined with hardware cloth so that it can hold shelled corn as well as ear corn. Elevating equipment should handle ground feed as well as small grain and ear corn.
3. *Location*—The structure should be located close to the livestock feeding areas. If two kinds of livestock are fed such as beef cattle and hogs, then the structure should be placed between the beef feeding unit and the hog shelters. It should be close enough to the beef unit so that shelled corn or ground feed can be blown or conveyed to self-feeders or feed bunk. The elevator within the granary should handle grain coming into storage and the structure should be so designed that feed can be moved from one bin or crib to another.

Courtesy Purdue University

No scooping here.

4. *Grain Processing*—space should be left for mills and equipment to handle grinding, crushing, shelling, mixing, seed cleaning, treating, and any other desired processing. Grain should feed by gravity from overhead bins into such processing equipment.

   On many farms where there is electric power it is possible to make use of overhead bins and gravity for automatic grinding, which saves a great deal in cost of equipment. Small one-half to one HP electric-driven mills can handle sufficient feed for a good-sized herd or flock.
5. *Blower or Conveyor*—A blower or conveyor will save many hours of work in moving the feed from the granary to the feed bin, self-feeder, or feed bunk in the feeding barn or lot.
6. *Self-Feeder*—Granaries can be designed so that the entire storage may be used as one large self-feeder. This arrangement is especially desirable for hog feeding. By the hinging of a bottom board, grain can run out onto the floor and operate as a large self-feeder. This is a real labor-saver.
7. *Drying Grain*—Some thought should be given to the possibility of constructing the cribs and bins so that an air vent can be connected to the blower and used for drying grain that is too moist for safe storage. Little work has been done on this but assistance can be had by contacting lumber dealers and state agricultural engineers.

BARN HAY-CURING

One of the new and somewhat revolutionary ideas in farming is barn hay-curing. It consists of putting hay in the barn before it is completely field-cured and then forcing air through it by means of a blower to finish the curing. It is often asked, "Is barn hay-curing all right or is it just a fad?" The system has been put in use over a wide range of conditions and, on the whole, users have been quite satisfied. There have been instances, however, where the operators expected too much from the equipment and have had difficulty.

Barn Hay-Curing

Barn hay-curing equipment should be looked upon as a "finisher." When hay is *partially dried* in the field and *then finished in the barn*, the quality is improved. Users of the system say that this means greater income, especially from dairy cattle, because:

1. Milk production per cow is increased.
2. Higher protein hay reduces cash purchases of protein supplement.
3. Less grain is required.

There is still some concern over the possibility of fires which may be started because of equipment failure; yet, the greatest disadvantage, expressed by those who have tried barn hay-curing, is the heavy work of moving only partially cured green hay onto the hay racks and into the barn, and distributing it over the mow—it requires a lot of elbow grease. Then when the time comes to feed the hay, it is packed down tight and is hard to get out. Because of

Because of its cellular nature, wood is an excellent insulator — the only commonly used building material which combines insulation value with a high degree of strength and stiffness.

the extra work many good managers have given preference to "grass silage" which can be handled with power equipment.

Barn hay-curing has had greatest adaptability *in areas of high rainfall.* Some equipment is being installed in sections of relatively low rainfall where hay can normally be stacked outdoors. In these sections, the money spent could be more profitably used on labor-saving structures or equipment.

Method of Barn Hay-Curing

Briefly the method of handling hay for curing in the barn is as follows:

1. *Cutting hay*—Hay should not be cut too green. It is best to cut it at sunrise on a clear day and leave it to dry in the mower swath for two hours before windrowing.

2. *Field Drying*—It is important to let the hay partially dry in the field. It should remain in the windrow until the moisture content is reduced to 30 to 45 per cent (one-half to two-thirds dry). Leafy hays such as alfalfa, clover and lespedeza should be brought to the barn before they become too dry and lose their leaves. Normally this is four or five hours after cutting. Soybean hay and first-cutting alfalfa may require 30 to 40 hours before bringing to the barn. Normally hay is cut one day and put in the barn the next.

3. *Hay Storage*—Hay should be spread evenly and *not* tramped except along the wall to help seal against air leakage. Chopped hay may mold where stepped on. Normally, not more than six to eight feet of loose hay should be dried at one time. The depth of each layer and total depth depend upon the air capacity of the blower. After the first layer is dried, then additional layers can be added.

DEPTH HAY CAN BE PILED WITH DIFFERENT BLOWER CAPACITIES

Kind of hay	*Moisture Percentage* when going in barn*	*Blower Capacity**, cu. ft. per min. per sq. ft. floor space*	*Max. Depth of layer of hay at one time*	*Total Max. Depth of Hay*
Loose	35 to 45%	10 to 15	4 to 6 ft.	16 ft.
Loose	35 to 45%	15 to 20	6 to 8 ft.	20 ft.
Chopped	25 to 35%	15 to 20	3 to 4 ft.	12 ft.
Baled (See note on baled hay)	22 to 25%	15 to 20	6 to 8 ft.	14 ft.

*Highest figure indicates maximum percentage of moisture that should be put on a barn drier.

**Delivered against ¾ to 1 in. static pressure for loose hay, and 1 to 1¼ in. for chopped and baled hay.

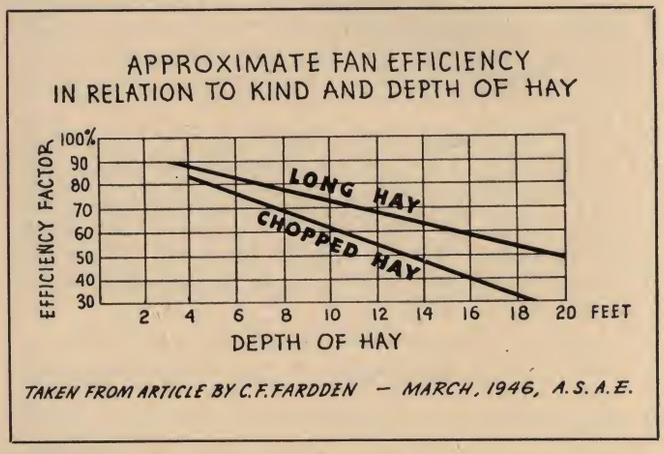
Note on Baled Hay Curing—Use only for hay that is baled just a little too wet for safe storage—hay that might heat some and mold in the bale. Slatted floor dryers are best for baled hay. Hay should be loosely baled and tightly stacked.

4. *Blower Operations*—The blower should be started before putting hay in the mow to help keep all ducts open and should be continued in operation day and night until the moisture percentage is reduced to 20 per cent. The top layer will dry last. When the hay feels dry on top, the blower can be shut off. Hay should be checked every day for three or four days to make sure that it does not *start heating.* During rainy days the blower should be operated only enough to keep the hay cool. One hour of operation at six-hour intervals will usually keep the temperature down. During the final stages of curing, the blower may be shut off at bed time and operated on a time-switch control for one hour during the night.

Types and Size of Blowers

Propeller-type fans are the most efficient. They do not overload the motor when starting to fill the mow and they deliver the required amount of air as the mow is filled. They make considerable noise, but usually this is not objectionable because it lets one know the blower is operating properly.

Minimum air requirement is 10 cubic feet per minute per square foot of floor area. Under some conditions as much as 20 cubic feet per minute may be used. Allowance should be made for an abundance of air capacity because as the hay is piled deeper, increased pressure is required to force air through it and leakage at the walls increases. The combination of these two factors may reduce the drying capacity when hay is piled up to 15 to 20 feet deep to the point where it may be only one-half to one-third as effective as when the hay was 4 or 5 feet deep.



Construction Features

There are several different types of air duct systems, all of which work satisfactorily. One of the simplest to construct is the Ohio system. A slatted floor system is in use in Pennsylvania.

The hay mow floors must be tight to prevent air leakage. All ducts should have individual controls so they may be opened or closed.

Air Duct Plans

Local lumber dealers can aid in obtaining plans for installing efficient barn hay-curing systems. State Agricultural Engineers are always willing to help.

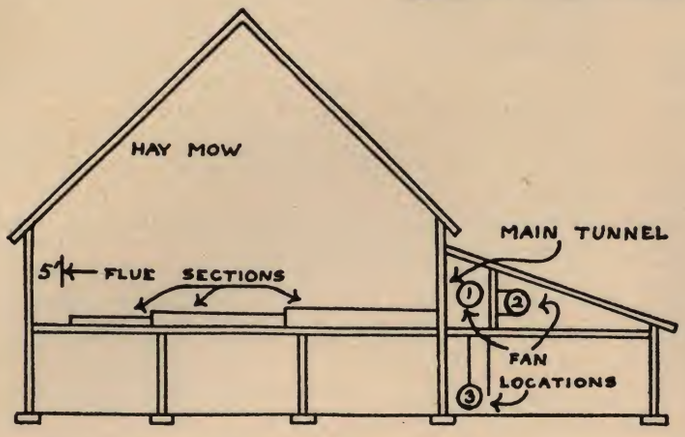
PROCESSING FARM PRODUCTS

Vertical Farm Diversification

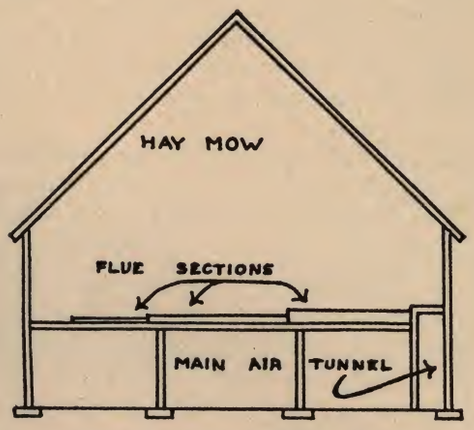
Those who are in the field of exclusive raw production receive the lowest return for their time. The farmer who carries his products one or more steps beyond raw production increases his opportunity for profits. He is putting his operation closer to that of the industrialist who oper-

Well-planned wood buildings increase farm profits. They are warmer in winter, cooler in summer and protect crops, livestock and machinery. They pay their way.

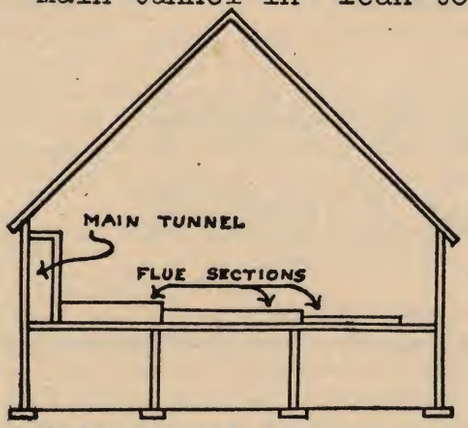
OHIO SYSTEM



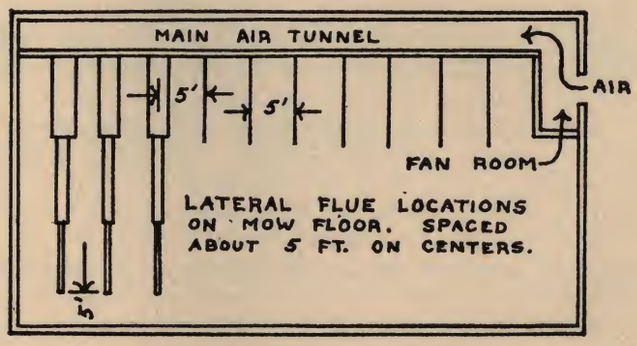
Main tunnel in "lean-to"



Bank barn with drive



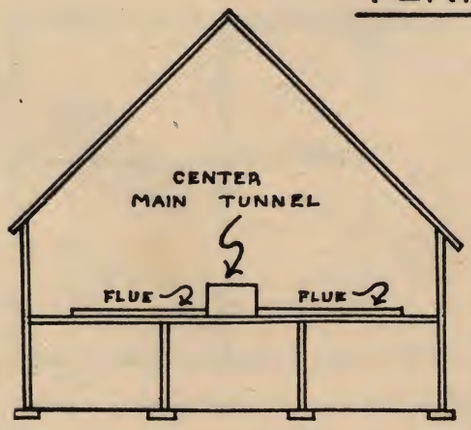
Main tunnel in mow



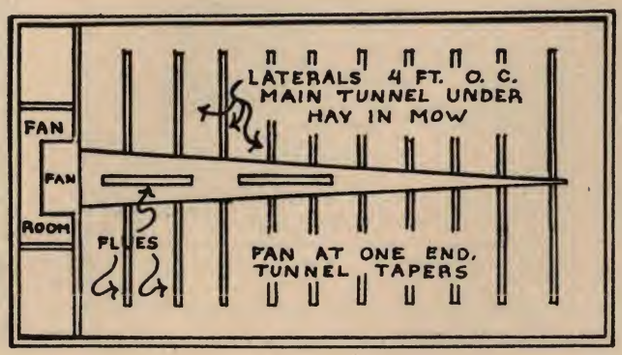
Suggestions for mow floor layout of tunnel & flues

NOTE: Tunnel may be along any side or end. Fan and motor may be in almost any location. It may be located above, below, level with tunnel, or at end or side.

TENNESSEE SYSTEM



Center Tunnel System



Plan View Center Tunnel System

D.A.S.

(FROM OHIO STATE UNIV. MATERIAL)

ates on a *fixed margin, including a profit.* The farmer who feeds his crops to livestock is carrying out one form of vertical farm diversification. He is going further when he bottles his milk or butchers and sells a hog ground up into a high-quality sausage. Vertical farm diversification means doing more and more with the most profitable crops to reach greater margins.

Farm families, in which there are several boys and girls, have a fine opportunity for increasing their income and parents can thus maintain the young folks' interest in the farm.

First-step processing of agricultural products has perhaps the greatest possibilities in vertical farm diversification. It can be started in a small way and can grow into a sizable business. Present farm structures can be remodeled to set off a room or place in which to start new endeavors. Those who have once established themselves will want special structures to take care of their particular requirements. Some of the fields that have special possibilities are briefly discussed as follows:

Feed Grinding and Mixing

Livestock farmers will want to set up an efficient unit for grinding and mixing their own feeds used on the farm first. An aggressive operator can go further by mixing feeds for his neighbors. Protein supplements and locally grown feeds can be purchased, ground, mixed and bagged according to formulas recommended by the state agricultural college. Instances have occurred where such businesses, after becoming established, have overshadowed profits from farming.

A feed grinding and mixing unit can be incorporated with the farm central grain storage without large expenditures. Low-cost round wood bins constructed with laminated wood hoops make very economical storage. Two or more such bins, a simple elevator, a processing room, scales, and grinding and mixing equipment make a good setup.

Livestock and Poultry Processing

Few farms are well equipped for butchering. The main essentials of a good setup are:

1. A place for heating water.
2. A specially built scalding vat and table.
3. A hoisting beam.
4. A place for rendering lard.

Most farms do not have enough butchering to warrant a special slaughter house. A machine shed or shop with wide doors that can be opened to the south on a sunny winter day makes an excellent place for butchering. An easily cleaned floor and a strong over-head hoisting beam add to the convenience. A special scalding vat furnace connected to the shop flue with exchangeable pans simplifies the jobs of heating water and rendering lard. Portable tables can be moved into a clean heated shop and the entire "mess" of butchering can be kept out of the house.

Butchering on a larger scale, beyond home requirements, can best be carried on in a small slaughter house such as illustrated.

Dressing broilers for freezing or for the fresh markets requires the following equipment:

1. Scalder
2. Plucker
3. Table for Pinning
4. Singer
5. Washer
6. Cooling Tanks
7. Drawing Table
8. Packing Table
9. Quick Freezer
10. Zero Storage

Processing Dairy Products

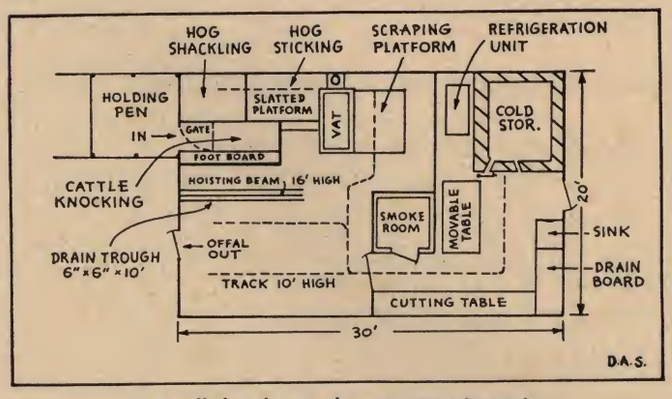
The making of high quality butter, cheese, cottage cheese, and other dairy products presents opportunities for obtaining higher returns in many localities. The business can be started in a small way and as the trade develops, special processing rooms or buildings can be constructed. Such rooms should be adjacent to the milkhouse.

Small pasteurizing and bottling plants are desirable where there is a special market.

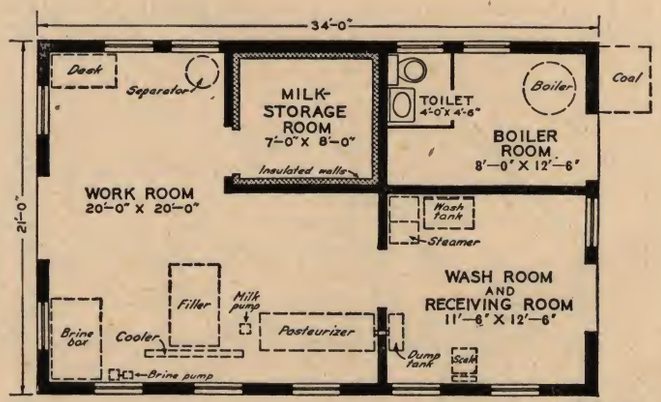
Fruit and Vegetable Processing

Fruit and vegetable processing should start with a well arranged room or portion of the basement. The task of canning and freezing becomes a real pleasure when the work is *kept out of the kitchen* and all tools and equipment are arranged for "assembly line production." It is surprising how large quantities of food can be processed. If a fruit and vegetable processing business is going to be established, it should be on a *quality* basis.

Processing rooms or "Kitchshops" if possible should be located adjacent to the kitchen in order to save steps. In addition to canning and freezing, equipment for doing



A small slaughter and meat processing unit.



Courtesy U.S.D.A.

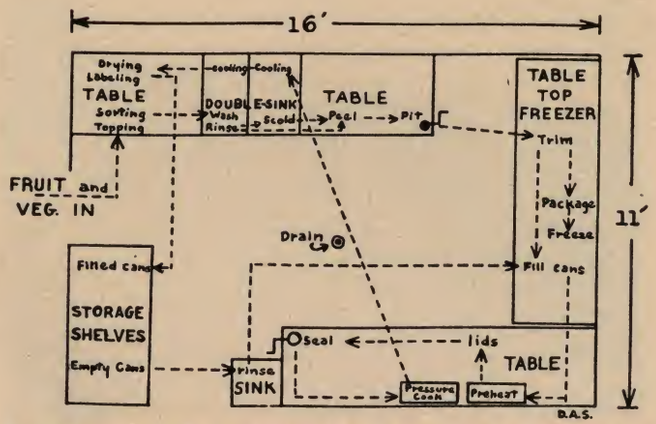
Floor plan for milk plant of 100 gallons daily capacity.

It is significant that eight out of ten families generation-in and generation-out, have elected to build their homes of wood.

Your retail lumber dealer can give you timely, helpful building information.

other work may be included in the kitchshop, such as: laundering, making soap, separating milk, pressing cheeses, grinding cereals for breakfast foods and flour, and grinding and processing of meat. At butchering time, the wide spacious tables make it an ideal place for working up the pork, beef, mutton, or poultry.

Owners of farms who specialize in fruit and vegetables, can well consider the addition of a special processing room or building. A good sales outlet through a roadside market presents an excellent opportunity for adding a processing room. There would need to be more storage space than that shown in the sketch, part of which might be available in the sales room of the market place. The suggested processing equipment shown in the sketch would be adequate for handling several thousand dollars worth of quality products.



A well planned food processing room. Additional storage space is provided by overhead cupboards. Tables are enclosed as cabinets for storing pans, cooker, and other equipment used in canning and freezing.

CHAPTER 5

PROPER BUILDING IMPROVEMENTS REDUCE FARMSTEAD WORK

On many farms the hours of man-labor can be more than *cut in half* by using buildings, other improvements, equipment and methods that are *planned* for *saving time.*

Much has been done to increase the field efficiency, yet little help has been offered farmers for reducing work or increasing the efficiency of work around the farmstead. From 50 to 60% of the farm work, done by midwestern farmers, *is in and around the farm buildings!*

Fields
95% of farm area requires only 40 to 50% of all farm work.

Farmstead
5% of farm area requires 50 to 60% of all farm work.

The amount of *farmstead work accomplished* per man commonly varies as much as *100 per cent from one farm to another.*

Practical farm managers, for years, have studied farmstead work efficiency and have brought together, from wide varieties and types of farms, labor-saving ideas on building designs and systems of doing farmstead jobs. The National Farm Work Simplification Project with headquarters at Purdue University has also made many studies and some of the material on simplifying farm work used herein has been drawn from their research.

There are ways of *reducing farmstead work* for all livestock, and crop enterprises. Some of the best known ways are shown here.

Beef Cattle Farmstead Work

The right kind of building improvements, equipment, and methods of feeding and handling cattle can make a difference of several hundred per cent in the amount of work required to do the job. Beef cattle normally require a relatively small amount of labor; nevertheless, a great deal can be done to lower costs and shorten the hours of work.

The best methods of obtaining highest profits and reducing labor requirements for handling beef cattle are:

1. *Use a low-cost open shed*—Cattle profits will not justify elaborate expensive barns. Face the shed to the south or southeast. Even in northern climates, open sheds furnish sufficient shelter for beef cattle. For cows dropping calves during midwinter, an enclosed maternity pen is desirable.

2. *Locate open shed close to feed*—For western ranch areas, locate the cattle shed close to the stacked hay or a good place for feeding. For more humid areas, if the program calls for feeding large amounts of grain, the shed should be close to the crib and granary. If large quantities of roughage are fed for just "roughing cattle through winter," then locate the shed adjacent to, or combine it with, the hay storage building.

3. *Confine the feed lot*—A feed lot confined to not over

Courtesy Ohio State University

Low-cost buildings do the job and leave more profits to the owner.

(D.A.S. Photo)

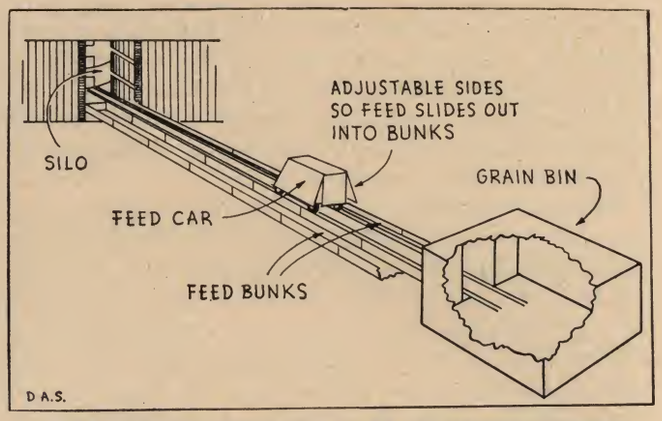
A cattle feeding shed in Illinois. Note grain storage bin at one end. Hogs are self-fed within the area fenced off at the right.

100 square feet per steer, including the shelter area, will result in the production of two to four times more manure, than a large open lot. It will pay real dividends even when purchasing the total requirement of ½ to ¾ ton of straw per steer. Approximately 9 tons of manure will be produced per ton of straw used. In most areas manure is worth $3.50 to $8.00 per ton in the form of increased crops. Make the farm a fertilizer factory.

4. *Build cattle barn or shed to accommodate power manure loaders*—The cattle building should have at least eight

Courtesy U.S.D.A.

A good scale does away with guess work.



This labor saving arrangement can be placed either inside the cattle barn or in a cattle shed adjacent to the granary.

foot head clearance. A power loader really takes the backache out of this job. It saves several weeks work each year and gets the manure hauled at the right time and out on the fields where it will make money.

5. *Build a good substantial sorting and loading corral*—At shipping time a good board fence corral for sorting and handling cattle not only saves time but makes money in reducing heavy shrinkage. Locate the corral adjacent to the feed lot. For the main fence, use 8-foot posts, 3 feet in the ground and 5 feet above; space 6 feet apart and use 2-inch lumber for rails. For the loading chute, space posts 4 feet apart. Keep the inside of the chute 28 to 30 inches in width so that cattle starting up it cannot turn around. A chute with a floor 46 inches high will fit most truck beds.

6. *Weigh cattle regularly*—Have a good scale connected with the corral and *know* how the cattle are doing.

7. *Arrange the feeding method so feed is not handled more than once*—Grain can go direct from the crib and granary into large self-feeders, or overhead bins for hand feeding. Hay should go from storage into the full length of the hay feed bunk without further distribution. Silage can go direct from the silo into a distribution cart or wagon.

8. *Eliminate the scooping job*—Where grain is ground, shelled, or moved to feeders or feed bunk, make full use of

(D.A.S. Photo)

This time-saver eliminates the scooping job. Grain is ground and blown into the hopper directly over the feed bunk. When it is time for feeding the operator simply opens the small doors and the feed rolls out.

"Farm buildings are predominantly of wood construction. Over 90 percent are made of wood in spite of competition from other materials."—Frank J. Hallauer, Principal Engineer, Forest Service, U.S.D.A.

(D.A.S. Photo)

Another large self-feeder arrangement which gives efficient use of labor in feeding of both grain and hay.

(D.A.S. Photo)

A double duty fence.

portable and permanent conveyors, blowers and elevators. When grinding, allow grain to fall by gravity directly into the mill by making an opening in the side of the crib. Shelled corn or small grain can be fed into the mill from overhead bins. A blower can elevate the ground feed directly to the place where used or into the wagon or truck. A small portable elevator with a hopper large enough to permit a truck to dump a load of feed at one time, is a great time-saver. It can save a lot of work loading and unloading trucks, elevating baled hay into storage, and elevating ensilage out of trench silos.

9. *Use large bin type self-feeders*—When cattle are carried on full feed of grain, use large capacity (wagon load or more) self-feeders or feeders equipped with manual controlled openings for simple hand feeding.

A cattle feeder in Nebraska has made a 4,000-bushel granary into a self-feeder, has installed automatic watering, and stacks the hay in the lot. He can handle "100 steers on feed with an average of only 10-minutes time per day." (University of Nebraska Extension Circular CC-81.)

10. *Mix grain and supplement at time of grinding*—Feeding time is saved when protein supplement is mixed with the grain at the time of grinding.

11. *Use portable feed house for field feeding*—A portable field house either on skids or on wheels eliminates the job of hauling feed every day when cattle are fed on range or pasture.

12. *Have large hay bunks*—When hauling hay to the lot, the bunks should be large enough to hold at least a load. Still better, have hay stacked in or beside the lot and feed without hauling.

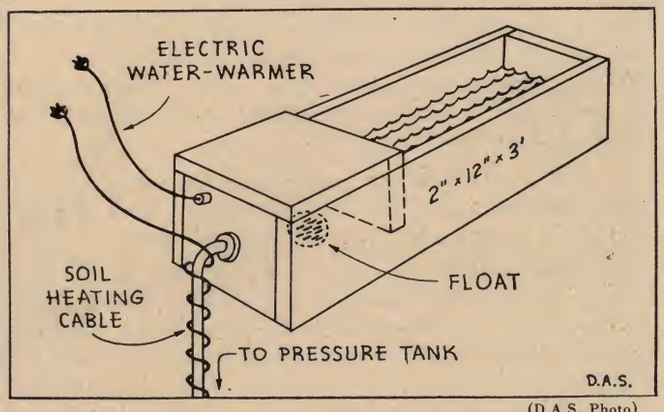
13. *Feed hay in the field when roughing cattle through winter*—Feeding in the field makes it unnecessary to haul the hay in and the manure out.

14. *Water cattle automatically*—Where streams or ponds are not available to the feed lot, pipe water under pressure to a *small* "drinking box." Keep it from freezing by using an electric immersion heater and soil heating cable around the pipes, or packing 10 inches of manure between framework and the box and around the pipes. Two square feet of open surface drinking area is sufficient for each fifty steers. It is not necessary to try to keep a great big tank of water from freezing. Place the drinking box in the shed preferably to the southeast—away from the normally cold side.

Where water is not available under pressure, board over the top of the water tank leaving only a small drinking area for winter.

Courtesy Iowa State College

Three weeks' supply of feed is available right where used for range and pasture feeding.



(D.A.S. Photo)

Only a small amount of water to keep from freezing in this winter watering arrangement.

Wood buildings are a structural unit and as such may be easily moved from one location to another.

(D.A.S. Photo)

A good tank cover helps keep water cool and fresh in the summer. A winter cover should fit inside the tank top and leave as little air space as possible between cover and water.

Dairy Farmstead Work

It takes some farmers *four times* longer to milk cows and twice as long to feed them as others. The main reason is that their buildings, fences, and other improvements and equipment are not designed or arranged for saving time and steps.

The following are goals that can, and should, be attained for an efficient dairy enterprise.

Dairy Efficiency Goals for One Man

Chore	*Goal in minutes per cow per day*
Milking	5.0
Feeding hay	0.5
Feeding grain	0.2
Feeding silage	0.6
Manure disposal, bedding	1.2
Total	7.5

New Hampshire Agricultural Experiment Station

When these goals are met, one man employed full time, and not doing field work, can handle forty to fifty cows, and still have time to take care of the breeding, calving, and young stock.

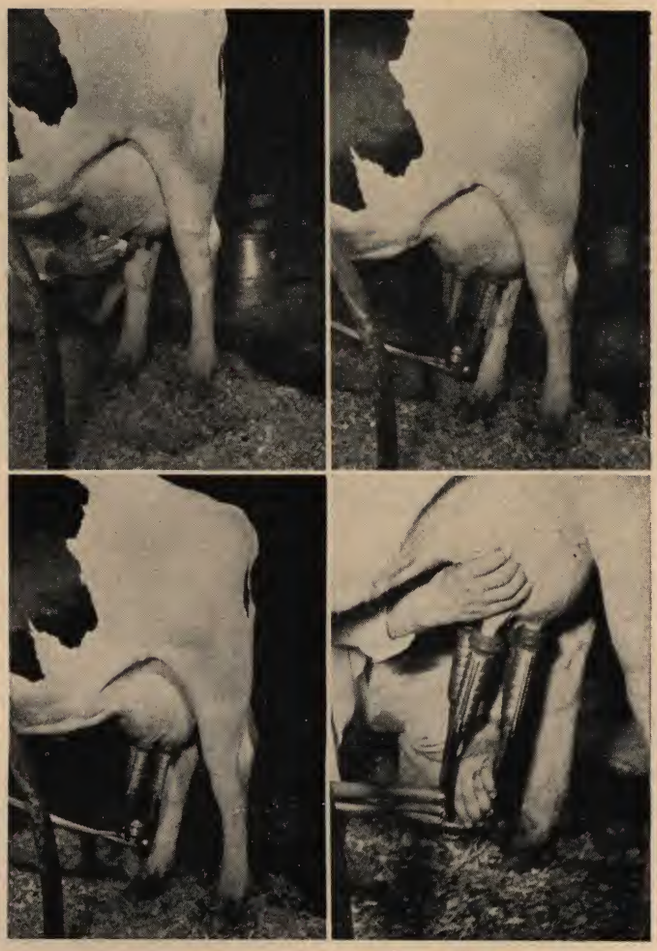
Here are 10 of the "top notch" methods of eliminating and reducing farmstead dairy work:

1. *Use loafing sheds and barns*—Where bedding is not a problem and where the milk ordinance will allow, adopt the "loafing" or "pen" type barn. This modern method of saving labor and the economical advantages are discussed in Chapter 4.

2. *Adopt an efficient milking room*—A two-, four- or eight-cow milking room will save a great deal of work. Chapter 4 discusses the efficiency of such units.

3. *Locate milk house close to milking room*—Local milk ordinances must be observed, but many miles of travel will be saved each year where the milk house is adjacent to the milking room. For pointers on milk houses see Chapter 4.

4. *Milk cows rapidly*—Massage teats and udder with warm (120° F.) water, draw first streams of milk in strip cup to observe condition of milk and udder, start milking one minute later. Use a milking machine to draw milk fast, and strip with milking machine.



Courtesy University of Minnesota

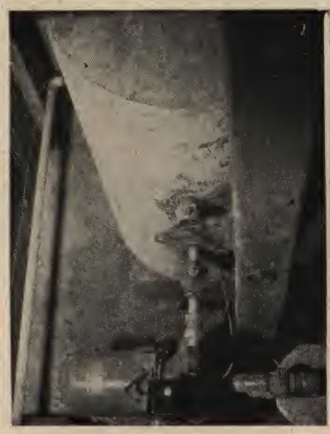
Above—**Massage Teats and Udder**
Below—**Don't Let Teat Cups Crawl**
Above—**Start Milking One Minute Later**
Below—**Strip by Machine**

5. *Water cows automatically*—For loafing barn—A small water box can be attached to the pressure system and regulated by a float. (For 20 to 25 cows a wood water box 10″ wide x 10″ deep x 24″ long, with approximately 1 sq. foot of open surface drinking area, will be large enough.) A small electric immersion heater will keep water from freezing. (See beef cattle section at the beginning of this chapter for drawing.) For stanchion barn—Use a water bowl between each two cows. Place a water bowl in each calf pen.

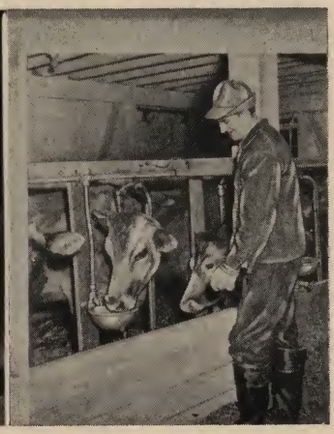
By a carefully conducted test ("Ohio Test Farm" where a practical farmer is cooperating with Westinghouse Electric Corporation on their program to find out where electricity makes money on farms.), an Ohio farmer saved 17½ days of work watering cows during the five winter months through the installation of an electric jet water system and water cups. This "labor-saver" eliminated the winter job of traveling *22.7 miles* while moving *151.2 tons of water*. In addition, it increased milk production 2.55% and the milk check $36.35 during the five months.

6. *Use partitioned feed bunks for herd feeding*—Where

the loafing barn is used, a great deal of time will be saved by feeding silage, hay, and a portion of the grain to the entire herd, similar to the method of feeding beef cattle. Each cow will receive an even amount when partitioned feed bunks are used.

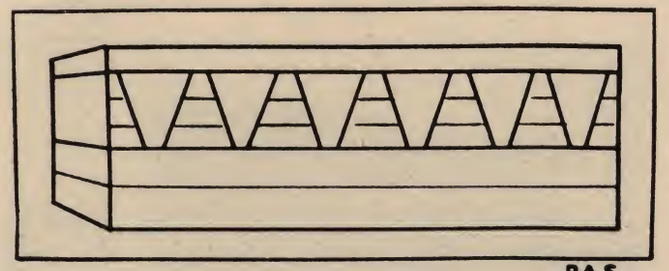


This equipment eliminates the job of pumping water



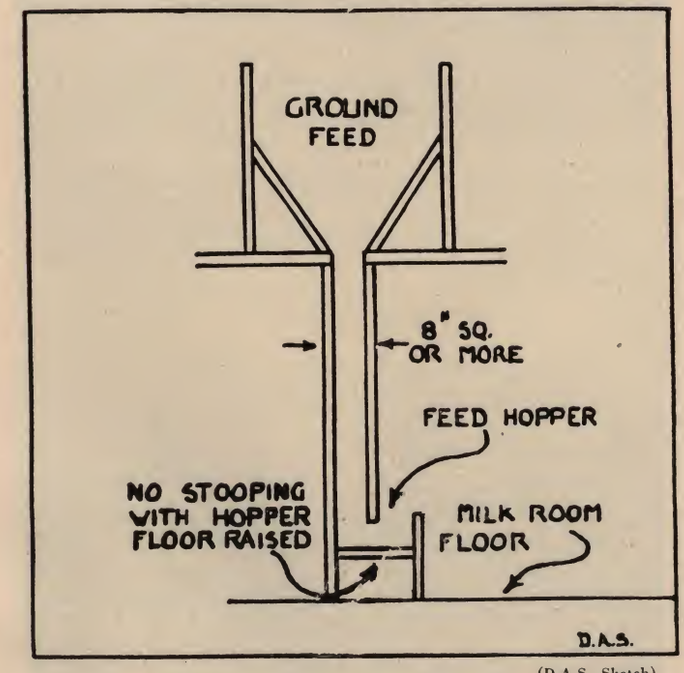
Courtesy Westinghouse Electric Corporation

Automatic watering increased milk production 2.55%



(D.A.S. Sketch)

This feed bunk whips the "boss" cow



(D.A.S. Sketch)

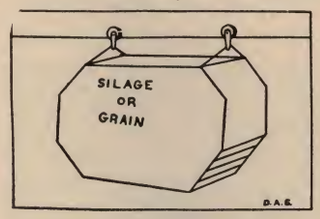
Overhead feed storage with hopper in milking room for quick and easy feeding.

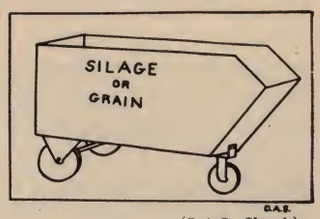
7. *Make use of gravity with overhead feed bins*—Where possible, install an overhead feed bin so gravity will keep the feed automatically ready, *right at the place where it is fed.*

8. *Arrange stanchion barns for circular travel*—Eliminate back-tracking and empty travel. Carry enough feed to complete one trip.

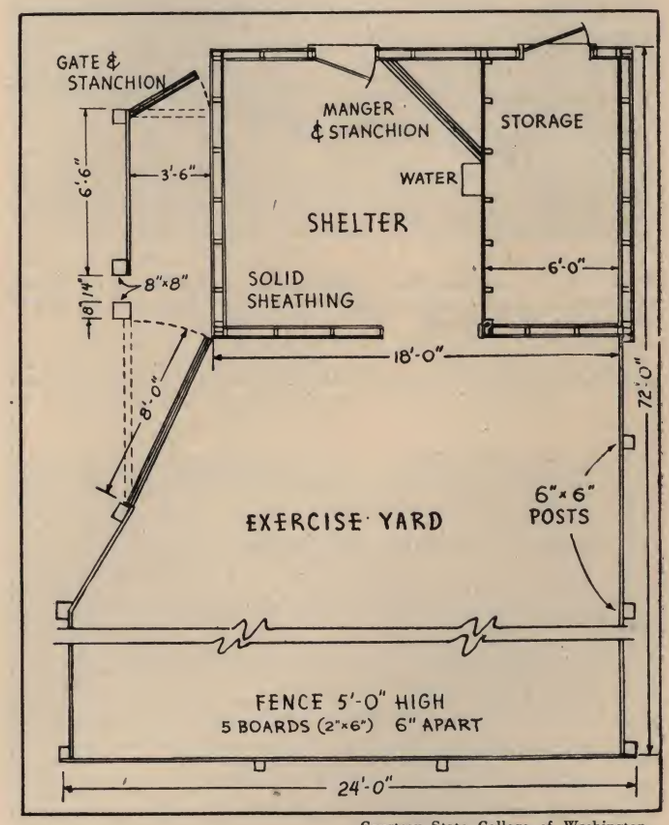
9. *Locate tools and supplies where used and have adequate equipment for each job*—Have feed carts, pans, baskets, buckets, forks, brooms, and shovels, as well as all milking equipment, as *close* to where they are used as possible. Use *large* buckets or baskets or, better yet, grain and silage carts, carriers, and other large capacity equipment to eliminate some of the necessary trips. *Keep the medicine cabinet in the barn* with supplies such as dehorning caustic, salves, and mastitis medicine.

10. *Provide a safe bull pen and breeding chute*—Where artificial breeding is not available keep the sire in a good pen. Build the fence with 8-foot posts on 6-foot centers and boarded with 2″ x 8″ x 12′ planks spaced 7 inches apart. Locate the breeding chute close to the cow lot and on the side of the bull pen.





(D.A.S. Sketch)



Courtesy State College of Washington

Hog Production Work

Five farmers in central Indiana worked only *1.7 hours for every hog sold,* reducing their average far below the state figure of 6.7 hours (Purdue University Bulletin 506). By using buildings and equipment that made it possible to carry out a well planned *system,* they were able to *eliminate ¾ of their work!* Part of the *time saved was used to increase their volume.* They averaged 27.5 sows, 395 market hogs raised, and 595 man hours per farm—*only 2 months of actual work raising almost 400 hogs to market weight.*

Their methods varied from farm to farm because of buildings, building layouts, available equipment, and size of enterprise. Yet each farmer studying his own situation was able to adopt a definite system for doing each job and thereby *produced 100 hogs* with about *500 hours less work* than the average.

Hog raisers in many sections of our country have worked out profit-making methods for their farms. Many others know there are easier ways of doing work but often it is difficult to find time to think out and plan a good program. Perhaps calling attention to tried and proved methods will give ideas for immediate adoption.

The 15 most effective ways to increase efficiency and eliminate work in raising hogs are:

1. *Use portable farrowing houses on clean ground*—To minimize disease and parasite hazards, use 4 and 6 sow portable houses with an alleyway between pens.

This gives the convenience of a central farrowing house and yet makes it possible to move houses onto clean ground for farrowing. Because of disease and parasitic elimination, more pounds of pork are marketed for the hours of labor spent.

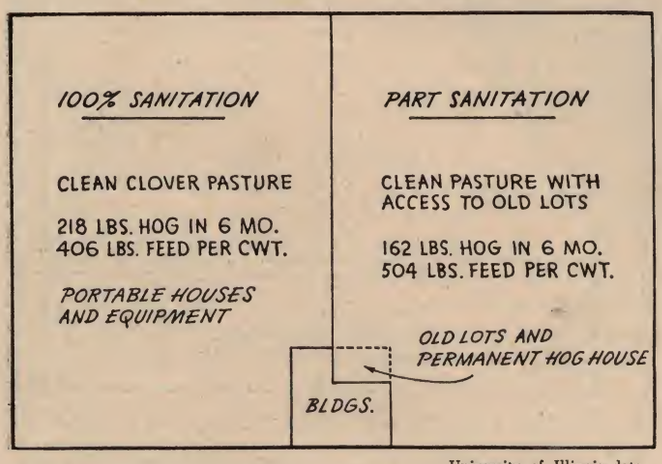
2. *Provide farrowing quarters for each sow*—Greater profit is obtained when all brood sows are farrowed in a short period rather than attempting to spread out the farrowing period. It has been found that the additional annual cost of supplying a full set of individual portable houses, as compared to one house for two sows, is only 14c per pig marketed from one litter. "Few hog producers would not be willing to pay an additional 14c per head to get the pigs of a more uniform size and to get farrowing and suckling work out of the way in advance of heavy spring work." . . . "Whether the hog enterprise involves a five-sow herd or a thirty-sow herd, adequate housing permitting farrowing in a short period is likely to increase the

Courtesy Farm Journal

Front view of portable 4-sow double unit hog houses. These houses are built in 2 units and separate at the ridge. They can be moved through any 12-foot gate.

(D.A.S. Photo)

It is more profitable to have farrowing quarters for each sow so all can be bred to farrow at about the same time.



University of Illinois data

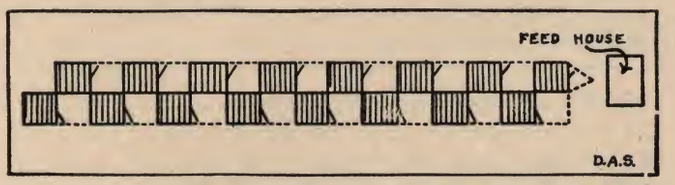
(D.A.S. Photo)

Keep farrowing quarters close to the dwelling, yet on clean ground.

In wood structures grades of lumber higher than necessary are too often used.

Courtesy Purdue University

Increase profits per sow by using electric brooders. 100 watt bulb with reflector or 150 watt reflector flood lamp. Electric brooders save 1½ extra pigs per sow. (Purdue University Bulletin 494.)



Information from Purdue University Bulletin

Arrange individual houses and pens in checkerboard rows.

(D.A.S. Photo)

Doane ear corn feeder

(D.A.S. Photo)

A labor-saving 100-bushel platform type self-feeder

profits from the enterprise. And as the enterprise gets larger, adequate individual housing becomes increasingly important." (Purdue University Bulletin 506.)

3. *Locate portable houses close to the farmstead*—Clean, legume ground should be available close to the farmstead for the location of portable houses. Fields should be arranged to accomplish this, especially for winter farrowing.

4. *Use pig brooders or supplemental heat*—Where electricity is available, 1½ extra pigs may be saved which will more than pay for the brooder in one spring farrowing (Purdue University Bulletin 494.) In northern climates where supplemental heat will make it possible to have early farrowing and thereby result in obtaining peak prices in August and September, early marketing will make $1.75 to $2.00 per cwt. extra over December marketing. This is approximately $400.00 extra income per 100 hogs sold. Early spring pigs make possible early fall pigs that will reach the peak spring price in March—still more profits—$1.00 extra per cwt. or more.

5. *Arrange portable houses for minimum travel*—Before farrowing time, when using *two, four,* or *six-sow portable houses,* fence off lots of approximately one acre each and place 4 to 6 sows in each pen. To save labor use temporary fencing and posts that can be driven. Feed and water each group of sows together and not individually, except for the first three days after farrowing. When using *individual portable houses* place four or six in an acre lot and feed and handle the sows as a group, or arrange houses in double rows in checkerboard fashion so that each sow has an individual pen. Make each checkerboard row the right length so that sufficient water or feed can be carried for a complete trip around it.

6. *Provide well ventilated sleeping quarters*—For bred sows and fattening hogs, open shed types are most satisfactory. Plenty of fresh air reduces chances of hogs taking flu. (See Chapters 2 and 6 on Ventilation.)

7. *Use portable feed house*—A feed house can be used in the field to hold feed at farrowing time and for temporary storage of protein supplement during the balance of the year. Such a portable building saves many steps and a large amount of time when located close to the place where the feed is fed or placed in feeders.

8. *Use ear corn platform self-feeders*—Where possible, use ear corn self-feeders that hold at least a good load of corn to minimize daily feeding time and aid sanitation by by keeping corn out of mud during rainy weather.

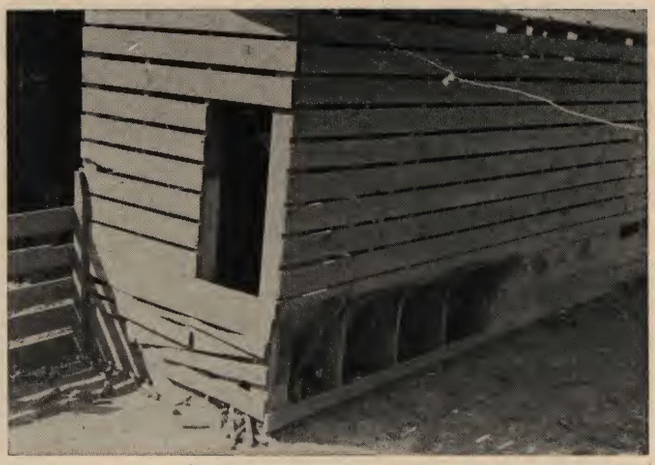
(D.A.S. Photo)

Platforms keep feeders away from mudholes

9. *Use large platform self-feeders for small grain, protein supplement, and ground feed*—Self-feeders save 50 to 75 per cent of the feeding time. For large herds they should hold at least a wagonload and preferably 100 bushels or more. For rolling topography, feeders should not be over 100 bushels in size to minimize difficulty in moving from one field to another.

10. *Use a platform to make the crib a self-feeder*—For winter feeding, place a portable platform along one side of the crib, remove the bottom slat, and make the entire crib a self-feeder; or, concrete the alleyway of a double crib and remove the bottom slat. Bring the hogs to the feed and *eliminate the job of scooping.*

11. *Self-feed corn from temporary field cribs*—Scooping, hauling and re-scooping is eliminated by self-feeding from temporary field cribs. It takes *78 times* more work to scoop, haul and feed ear corn from a permanent crib. Still more time is spent in shelling corn and feeding it in a self-feeder.



Courtesy Iowa State College

Make the entire crib a self-feeder

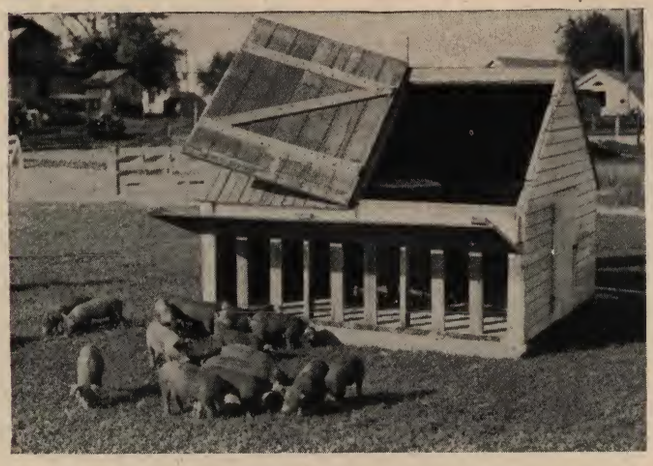
Time Requirements, Labor, and Equipment Costs of Different Methods of Preparing and Feeding Corn to Fattening Hogs for the Summer Feeding Period.[1]

Method of Feeding Corn[2]	*Man minutes per ton of corn*	Requirements per 100 hogs			
		Man hours of labor	*Cost of labor at 30c per hour*	*Total labor, machine costs*	*Cost per 100 lbs. of pork produced*
Ear corn, self-fed from field crib	0.5	0.3	$0.09	$0.09	$0.0004
Ear corn, hand fed from field crib	20.0	12.1	3.63	3.63	0.02
Ear corn from permanent crib at barn	38.7	23.5	7.05	11.05	0.05
Shelled at farm, self-fed	71.5	43.4	13.02	32.29	0.15
Shelled at elevator, self-fed	93.5	56.8	17.04	62.54	0.28
Shelled and ground at farm, self-fed	97.5	29.2	17.76	45.23	0.20
Shelled and ground at elevator, self-fed	101.5	61.6	18.48	136.78	0.61

Purdue University Bulletin 506

[1]No allowance is made for possible differences in rates of gain or in quantities of feed wasted.
[2]No charge for erection or use of cribs is included.

12. *Minimize grinding, shelling and feed mixing*—It seldom pays to grind feed for hogs, except oats and barley, or feed for suckling pigs. When necessary to process feed, blow it directly into a wagon or overhead bin to eliminate shoveling. Handle ground feed in bulk to eliminate the job of bagging.



A portable house used as a creep feeder. Labor can be saved if sows and pigs can both be put on a self-feeder.

13. *Build houses, feeders, platforms, panels, and other equipment for year round use*—Multiple pen open-front portable houses can be used twelve months a year for winter farrowing, spring shelter, shade, fall farrowing, and fall and winter shelter for both sows and pigs. Small individual houses have only limited use. *Removable floors* in portable houses *make the job of cleaning and scrubbing them much easier.* The floor panels can furnish summer shade by using them across the roofs from house to house. Summer portable watering platforms can be used for winter feeding platforms. Panels can be used at farrowing, for creep feeding, for shade by covering with straw, and for sorting and loading hogs. Make equipment work for more than just one enterprise—such as using a hog house for a chick brooder or a turkey shelter, or perhaps for calves in an isolated pasture.

14. *Water hogs from large tank placed on portable platform*—A field engine, pumping water from a well, pond, or creek into a large field tank with built-in fountains saves

Climatic conditions often dictate the type of farm buildings which must be built. Wood lends itself to any style of treatment, and buildings can be constructed to withstand the icy blasts of winter as well as the extreme heat of summer.

time. Put only sufficient gasoline in the engine to operate it long enough to fill the tank. It will shut off automatically. Place tank on a large portable platform to keep hogs from making a wallow. Where well, spring, or other water is not available in the rotation pasture, use a large capacity tank wagon or a large tank placed on a rubber-tired wagon running gear. Either is comparatively low-cost and requires only about *half* the labor of hauling water in portable fountains.

15. *Establish a medium-to-large enterprise*—On corn-hog farms greatest labor efficiency and highest returns are usually obtained when the hog enterprise is kept between 15 and 35 brood sows. Smaller numbers, particularly less than 10 sows, occasionally are not enough to encourage complete attention and planning. When handling more than 35 head, timely management and sanitation are apt to break down.

Poultry Production Work

Some farmers walk 53 miles a year in caring for 100 hens while others walk only 11 miles. Some poultrymen spend 67 hours a year taking care of 100 hens, while others do the same job in only 12.5 hours. (Data from Cornell University.)

A survey made by the U.S.D.A. showed that 89 per cent of the farm flocks were taken care of by the women on the farm. Often, alterations in the poultry house, equipment, and method of handling the flock will make it possible for the "Mrs." to see that the hens have proper attention. In addition, such changes can actually *save from ½ to ¾ of all the time spent.*

The best known ways to reduce work, increase efficiency, and net higher profits for both commercial and farm flocks are as follows:

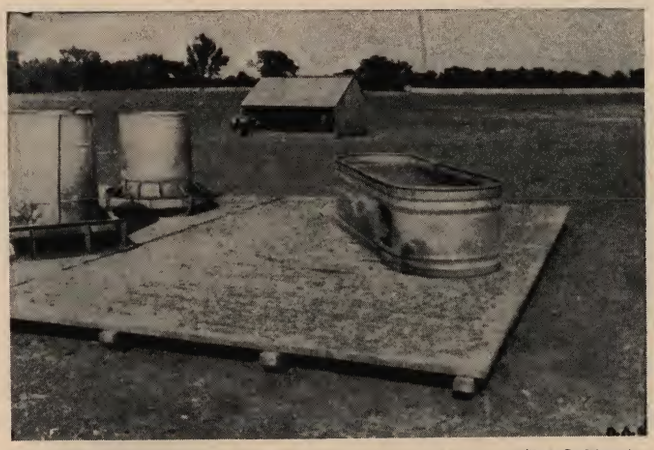
1. *Keep all hens in one building*—Except for very large commercial flocks, time is wasted when there is more than one poultry house. It takes more work to care for a given number of hens in several houses than to care for them in a few large pens in one large building. In addition, construction costs of one large building are less.

2. *Keep hens in large pens*—Some operators are now handling twice as many birds, with the same amount of labor, by using large pens of 1800 to 2000 compared to pens formerly holding only 500 to 600 hens. The modern method of controling disease in large pens is by alert management in immediately removing sick birds.

3. *When constructing new poultry houses* for the typical farm size flock, *make them one-story and of frame or pole construction*—They will normally give the most for the least. For large flocks see Chapter 4 for discussion concerning single-story and multiple-story poultry laying houses.

4. *Use portable brooders and range shelters to raise healthy chicks*—One of the first essentials for a healthy flock is to raise the chicks in clean brooders and on clean range keeping them away from the laying hens; otherwise, all of the work tending them may be wasted because of parasites and diseases.

5. *Start chicks in brooder house early*—A good brooder house is necessary to start chicks early, preferably between February 20 and March 15. Early chicks normally spread the work so it can be done at a time when the men can help, rather than during the busy planting season. A tightly constructed brooder house free from drafts with a double wood floor and an insulating pad under the hover



(D.A.S. Photo)

Watering platform prevents mudholes. 100-bushel feeder in background.

Courtesy Kansas State College

Interior view of new combination range and poultry house

Courtesy Kansas State College

Exterior view of new combination range and poultry house

Wood construction is easiest and most economical to add to or remodel. The lumber from wood buildings can be used again and again, when plans call for moving or improving buildings.

will adequately house chicks at temperatures 20° F below zero. Early chicks are money-makers because the pullets start laying earlier and on an average lay 188 eggs, compared to 146 eggs from the late pullets—42 eggs more per pullet in favor of the early birds! (Data from University of Missouri.)

6. *Use self-feeders in hen house and on range*—For highest egg production supplement self-feeders by placing some feed each day in hoppers. Feeders that hold several weeks' feed at a time save many a step. For the laying house, arrange a chute through the wall, so the feeder inside the house can be filled from outside. Provide 800 pounds capacity for one month's supply for each 100 hens. In addition to the feeder, it may be desirable to use one trough to each 200 hens. The "womenfolk" can easily check the feeder daily to make sure feed is available. For the range, feeders should hold a week's supply.

Use 2 x 6 studs to support wall feeders. Place feeder approximately 2 feet off the floor.

Use 3-ton portable feeders for turkeys. They are real labor-savers.

7. *Feed hens mash concentrate and grain, free choice, in feeders*—The feeding system must be adapted to every situation but usually "cafeteria" feeding of both mash concentrates and grain is most profitable and less time-consuming. Select high-producing poultry strains that require heavy grain consumption. Low-producing strains may eat too much grain when self-fed and become fat.

CAFETERIA STYLE MORE EFFICIENT*

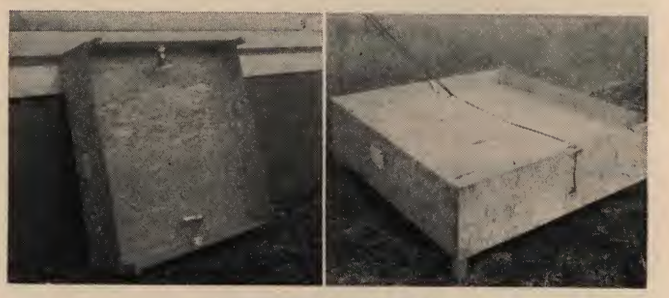
Method of Feeding	*Feed per dozen eggs* lbs.	*Feed cost per dozen eggs* (1938)
Mash concentrate and grains fed free choice in hoppers	4.9	8.6c
Mash, limited grain fed in litter and pellets on mash at noon	5.4	9.5c
Mash and limited grain fed in hopper	5.3	9.2c
Mash and limited grain fed in litter	5.4	9.5c
All mash	6.3	11.5c

*Data from Washington State Experiment Station.

8. *Store feed within the poultry house*—Overhead bins made of two compartments for holding large quantities of both grain and mash are time-savers if self-feeders are not used. When constructed in the poultry house the feed is available right where it is used. For large poultry units using a track and carrier the feed room may be arranged on the same floor so feed can be easily dipped and placed on the carrier. For small poultry units feed storage space may be within the pen for quick access when feeding.

9. *Feed poultry a well-balanced ration*—Where all poultry feed is purchased it is usually more profitable to buy a good commercial mixed product. Where home grown feeds are used keep green succulent feed before the hens for highest egg production. A rotation pasture will give more of this feed than anything else for the money and time spent. Keep it available in the summer. For winter keep bright legume hay in a rack. Good ensilage is succulent and high in vitamins.

10. *Provide automatic watering*—Water piped to the poultry house will eliminate the job of carrying eight to nine tons of water for each 100 laying birds per year. Provide one automatic waterer to each 500 birds. Each waterer should have panel protection to keep hens from throwing water on the litter. Pipes should be kept underground or wrapped with electric soil heating cable to keep them from freezing. Where piped water is not available, use a bucket supported by a rack holding it up off the floor. Farms with electricity will find immersion water warmers real labor-savers during cold weather. If the poultry house is only 60 yards from the water supply, and the poultry is watered twice a day, the operator will carry approximately *10 tons* a year (including water discarded)



Courtesy Ohio Agricultural Experiment Station, Wooster

Early chicks find comfort under an electric brooder as illustrated

Courtesy Ohio State University

Low-cost range feeder

Courtesy Pennsylvania State College

Overhead bins with downspouts make feed available where used

Construction and maintenance costs are low on wood buildings. Most farmers can build their own structures with wood. Your retail lumber dealer is the man to be consulted when you want to build anything — from a chicken coop to a home.

and walk a distance of *50 miles* per 100 birds per year. Where water is piped into the poultry house and both mash and grain are stored there, only about *half* as much time per 100 hens is required compared to no water or feed available in the house.

Courtesy Pennsylvania State College

An inside feed bin divided for storage of both grain and mash

Courtesy Pennsylvania State College

Bubbler type of waterer over drain tile. Water flows very slowly and keeps clean and fresh.

A portable barrel range waterer.

11. *Use deep built-up litter in the hen house*—Instead of having a small amount of litter and cleaning the house regularly, start with six to seven inches and gradually build up to nine to twelve inches of litter and clean the house only once or twice a year. The floor should be covered first with fine material such as sand or sawdust and straw added gradually.

12. *Save labor with low roosts and screened dropping pits*—The job of cleaning dropping boards weekly can be eliminated. It is necessary to clean dropping pits only three or four times a year. Roosts are built low, within twelve to twenty inches of the floor and the underside is boarded off. It is easier to teach pullets to roost on the low perches and there is less danger of rupture or bruising of feet which occurs when flying to high perches. More time is spent over dropping pits during the day; therefore, more droppings fall into the pit and the litter remains clean longer. Borax will control flies in the summer and the sprinkling of a fertilizer heavy in phosphate over the droppings will control odors and combine with the ammonia to increase the fertilizing value—a time-saver as well as a money-maker.

13. *Provide doors large enough to bring manure spreader into poultry house*—Large one-story poultry houses should have doors large enough so that manure spreader can be brought directly into the house. This arrangement eliminates most of the carrying and saves half the time in

Deep built-up litter eliminates frequent cleaning

Courtesy Pennsylvania State College

A good dropping pit—low cost, simple construction, low, movable, and screened.

"Observations made of a large number of frame structures indicate that as dry wood is relatively a good insulator no special precautions with respect to condensation are required for wooden bins." U.S.D.A. Farmers' Bulletin No. 1636.

cleaning the house. This arrangement requires level ground and a substantial floor.

14. *Have trap doors and chutes for manure removal from multiple-story poultry houses*—Arrangements should be made so that the manure spreader can be placed under the trap door or chute to necessitate only one handling. The chute should be located near the back of the house and close to the dropping pits.

15. *Give the hens plenty of fresh air*—Laying hens are being shut up too much. Ventilation can be provided by keeping the house not too tightly closed. See Chapter 6 for further discussion on ventilation.

16. *Screen all openings and keep sparrows out*—Sparrows carry such diseases and parasites as coccidiosis, pullorum, pox, mites, and others. Screen the doors and openings with one-inch mesh chick wire.

17. *Make equipment work the year round*—Range shelters can be designed with panels to cover the sides so they may be used for brooder houses and pullet laying houses. Raise more than one brood with the same equipment. Keep the laying house filled to capacity. If it is necessary to overcrowd, double up on management and provide more feeder and watering space. Build up the litter to a greater depth. Construct an outside runway with solid board sides and wire top to give more floor area. Watch closely for disease outbreak—use the axe.

Notice large doors at far end of house which permit bringing the manure spreader into the house.

Courtesy Pennsylvania State College

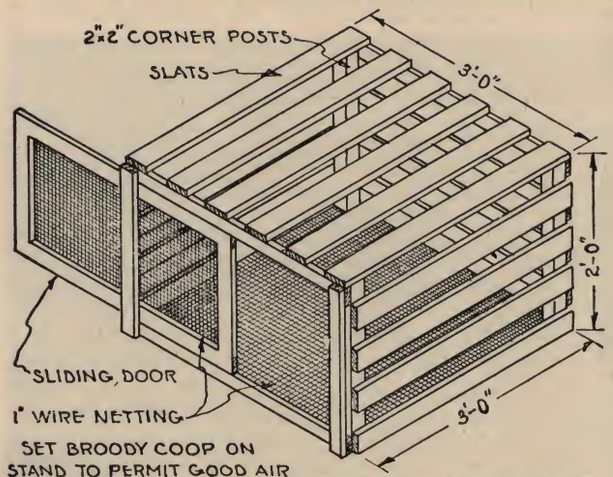
Litter chutes

18. *Have a coop available for broody hens*—Break up the "setter" by putting her in a coop.

19. *Cull hens regularly*—Use a hinged panel for a culling hurdle. Hens can be confined in one corner of the poultry house for ease in catching when culling. The hurdle should

Courtesy Purdue University

A range shelter may be attached to a brooder to act as a sun porch or "cool room."



SET BROODY COOP ON STAND TO PERMIT GOOD AIR CIRCULATION BENEATH. IF COOPS ARE STACKED TO SAVE SPACE, PLACE PAN UNDER EACH COOP TO CATCH DROPPINGS

Courtesy North Dakota Agricultural College

A coop easy to build

Courtesy Pennsylvania State College

An easy way to catch hens at culling time

be hinged and made of double panels, one 4 feet by 4 feet, and the other 4 feet high by 6 feet long.

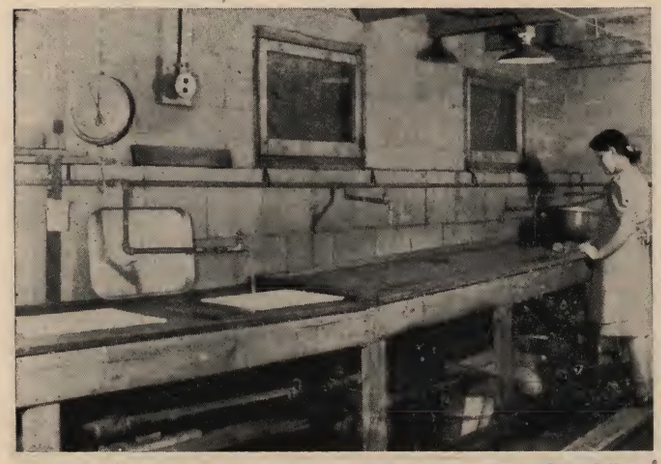
20. *Keep pullets separate from old hens*—The old flock should be closely culled to make room for the pullets. The house should be divided to keep pullets and hens separate. Pullet quarters should be thoroughly cleaned before they are moved in.

Courtesy Weekly Kansas City Star

This new compartment nest, 2 feet wide and 5 feet long is sufficiently large for use by 50 hens.

Courtesy Pennsylvania State College

Packing material within easy reach



Courtesy Pennsylvania State College

Water, sink and table used in dressing poultry for a better market

21. *Have nests that aid in keeping eggs clean*—Hours of time in cleaning eggs can be eliminated by having nests seven inches deep and filled with fine nesting material. The nest openings should be partially covered with a curtain, and the nests so hinged they can be easily and quickly pulled away from the wall for cleaning.

A new compartment nest constructed so hens lay in a darkened enclosed area, that is not partitioned off, prevents breakage and soiling of eggs.

Locate nests close to the entrance to save time and steps when gathering eggs. Perches on nests, feeders, and waterers should be not over two inches wide.

22. *Use lights in poultry house and brooder*—For laying hens use a time clock and give the hens a 13 to 14-hour day. More eggs will be produced when they are highest in price. For brooders, lights prevent piling of chicks and help keep away the chicken thief.

23. *Provide well arranged storage and packing rooms close to the center of the laying plant*—For commercial poultry farms well equipped rooms for egg storage and for grading and packing will help save time and improve egg quality. The rooms should be well insulated or basement constructed. Graded or hatchery eggs and dressed poultry all bring higher prices. For dressed poultry production, have a long work table with an abundance of running water.

Sheep Farmstead and Feed Lot Work

Good equipment for ease in handling sheep, whether breeding ewes or feeder lambs, is the best known labor-saver. Many of the principles discussed under "Beef Cattle Farmstead Work" in the early part of this chapter such as open sheds, and methods of handling feed apply to sheep.

Some of the better ways to save labor and increase efficiency to obtain higher profits with the sheep enterprise are:

1. *Use open sheds*—This applies to both feeder lambs

Courtesy Kansas State College

An open shed affords protection from rain and snow as well as from north and west winds. The outdoor lights are used at night to encourage the lambs to eat more.

Each member of a wood building is individually joined to other members. This is an important, money-saving factor if the farmer wants to add to or modernize the building.

and breeding ewes. They have good warm coats and do not require protection from cold temperatures. A dry place out of winds and drafts is all that is necessary. Many ranch feeders are successful using very little protection.

2. *Use self-feeders for lambs on feed*—Grain should not be fed in self-feeders by itself because lambs may overeat causing heavy death loss. It should be mixed with roughage at the rate of approximately 45% grain to 55% roughage. Experimental work at Kansas showed larger gains and decidedly lower feed costs when grain and roughage were kept at these proportions.

3. *Have feed bins close to feed racks*—Many steps and time are saved where the feed is available for quick distribution into the feed troughs.

4. *Treat sheep with phenothiazine and pine tar without handling*—Sheep will treat themselves for worms and nose flies when one of the simple feeders as illustrated is used.

5. *Have a good cutting and loading chute*—It should be connected directly to the feeding pens. By flaring the top out, both lambs and ewes can be sorted in the same chute. Board the chute panels solid, 30 inches high, 10 inches

Courtesy Kansas State College

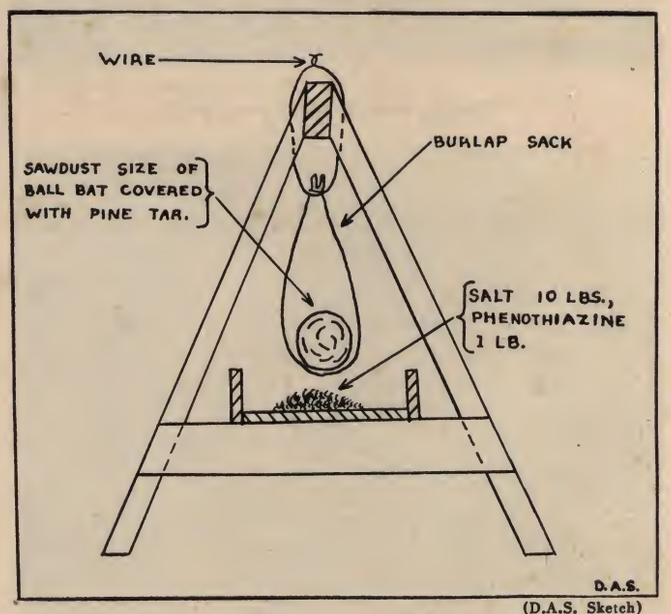
Self-feeders lined up to save time in filling. They should be placed close enough together so a truck or wagon can be driven down between two rows and feeders in both rows filled at the same time. If placed north and south, exposure of both sides to the sun will help keep the feed fresh and free from mold. Feeders should be placed at the high place of the lot where lambs like to stay. An "overflow" lot for the lambs when filling the feeders will prevent many injuries.

This labor-saving feed hopper is filled from the second floor

A good combination grain and hay feeder

Courtesy Purdue University

A barbed wire wrapped with tar-soaked sacks is tightly stretched lengthwise of the trough centered at 4 inches from the back, 6 inches from the front, and 4 inches above the floor. A mixture of one pound of phenothiazine and ten pounds of salt is placed in the trough. Sheep paint their noses with pine tar as they lick the mixture and thereby treat themselves for worms and nose flies at the same time.



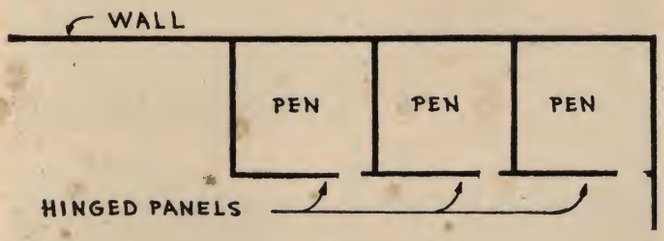
(D.A.S. Sketch)

Sheep bump their noses on the burlap and pine tar as they lick the salt and phenothiazine.

All West Coast Woods have a high heartwood content. Heartwood is more resistant to decay than sapwood, contains less moisture, shrinks less and is more likely to stay in place without warping and twisting.

apart at the bottom, 18 inches apart at the top, and 14 to 20 feet long. Wedge the cutting pen into the chute at one end and, at the other, hinge a gate 30 inches from the end at center so it can be swung from one side of the chute to the other for cutting sheep into two separate pens.

6. *Use hinged panels for lambing pens*—Two panels 4 feet long, 30 inches high, made of 1 x 4's and hinged together, may be placed along a wall, forming 4-foot square lambing pens connected to each other.



7. *Creep feed lambs when marketing early*—Panel off a small pen for feeding lambs after they are 2 weeks old. A panel made with upright 1 x 4's with 7 to 9-inch openings will allow the lambs to go in and will keep the ewes out. Lambs and ewes are hard to separate; therefore, creeps should be close to the place ewes are fed.

8. *Have a permanent dipping tank*—When large numbers of sheep are handled, much time is saved by having a good dipping tank so they can be quickly cleaned of ticks, lice, and scab mites.

9. *Provide fresh, clean water*—Place a board structure 10 to 12 inches above the edge of the water tank to keep sheep out of the water. The tank or trough should be at least 75 to 100 feet from the feeders, otherwise lambs will carry feed in their mouths and foul the water. Water heaters may be used to keep water from freezing or the tank can be placed over a pit filled with manure containing considerable straw which has not been decomposed by bacterial action.

10. *Provide movable shade*—Where natural shade is not available, it should be provided in the pastures. Shades, approximately 5 feet high, can be constructed on runners so they may be moved from one field to another. Ewes need approximately 10 square feet of shade area per head.

Courtesy Agricultural Experiment Station and Extension Service, University of Illinois

Sheep should be dipped after shearing and before going into winter quarters if parasites are present.

CHAPTER 6

CONSTRUCTION FEATURES THAT SAVE MONEY

Frame construction is the standard for farm buildings—time tested and economical. This system is so well known by contractors, carpenters and farm builders that we are not elaborating on it in this book. We suggest you consult your local retail lumber dealer for complete and detailed information.

There are other ways to save money when constructing, repairing, or remodeling farm buildings. Some of the more important features have broad application. For example, the principles of low-cost pole frame construction can be applied to practically every farm service building. This chapter discusses the more important factors to be given consideration in farm building construction.

Shells and Interiors of Farm Buildings

When deciding on the type of building to construct, it is well to consider all factors as outlined in Chapter 2. One should then work out the *most efficient method for systematizing* the handling of crops and the feeding and handling of livestock and *construct the building to fit the system of operation.* Top efficiency cannot be expected when the operator first builds the structure and then later attempts to adapt it to a method of handling crops and livestock.

Working out the "system" involves the location of the new building in respect to other structures, feed lots, methods of handling and storing feed, and all other factors directly related to the use of the building in question.

The way in which the building will be used usually indicates whether it should be of one- or two-story construction.

Farm buildings should be looked upon *not* as a whole or as one part, but as *two separate parts*—the *shell* and the *interior*. Detailed planning of the buildings involves two distinct steps.

First—

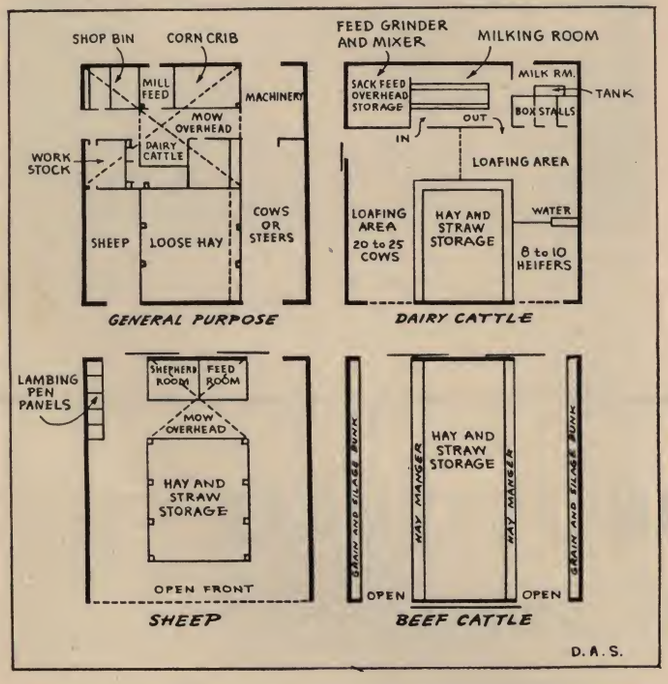
Plan the floor and interior arrangement for the most efficient handling of crops and livestock.

Second—

Select the type of construction and roof style that is best adapted to the "system" or interior arrangement, yet fits the topography, climate, and other conditions of environment.

Floor Plan and Interior Arrangement

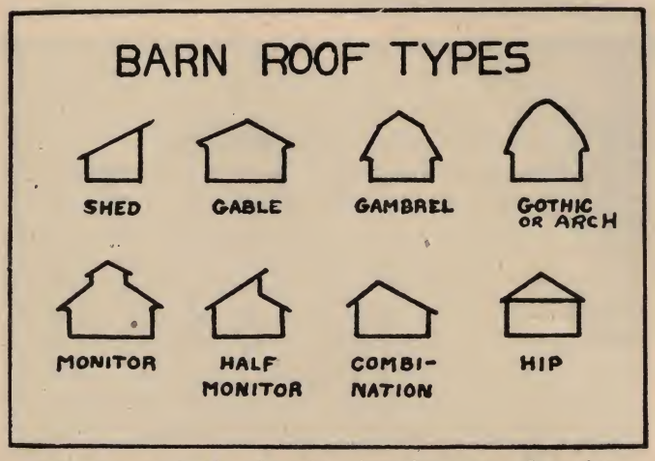
Interior arrangements should be adapted to individual requirements. One building shell may have many different interior arrangements as illustrated with in the floor plans at the left, all of which are adapted to the same shell.



Shells of Farm Buildings

The selection of the type of construction and style of roof, usually is determined by:

1. *The System of Operation—*
   Mainly as it is related to the required height of the building for carrying out the method of handling feed and livestock.
2. *Cost—*
   Some types of construction cost twice as much as others.
3. *Personal Preference—*
   Likes and dislikes, and matching style of other buildings.



Almost any style of roof can be adapted to a given floor plan.

Construction Features to Achieve Low Cost

The following outline shows a number of construction principles which experience has indicated to be satisfactory and which will reduce building costs.

1. *Pole Frame Construction—*
   Less labor and material.
2. *Arch Construction—*
   Less material and labor.
3. *Cross Pier Foundation—*
   Less foundation material.
4. *Bolts—Glue—Timber Connectors—*
   Enable use of lighter lumber.
5. *Single Story Construction—*
   Avoid heavy overhead loads except where good use can be made of gravity. Carry hay and grain weight on ground floor.
6. *Additional Height—*
   Get more space for same foundation and roof. Particularly adapted to hay and grain storage.
7. *Simple Type Roof—*
   Single slope or shed type is lowest in cost. Gable or straight pitch requires less labor and material than gambrel or other irregularly shaped roofs.
8. *Proper Bracing—*
   Lighter studding and rafters if braced. Have bracing members right dimension—for example, 1 x 12 instead of 2 x 6 as a tie in corn cribs.

Low-Cost Pole Frame Construction

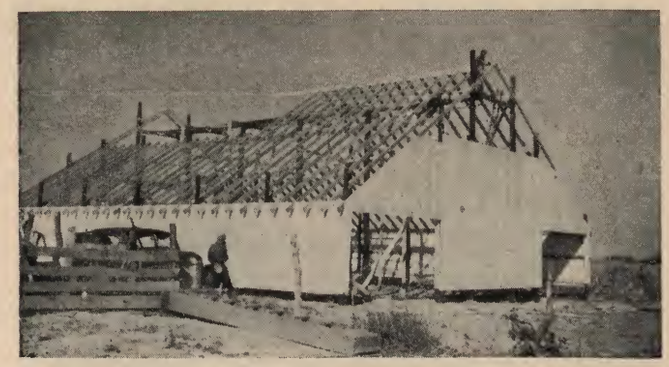
The use of modern pole frame construction is worthy of careful consideration for many farm service buildings. Many early buildings were pole frame, but the practice was discontinued, due to shortness of life of the customary farm-cut poles. *Treated* poles have eliminated the short life objection and now that poles are readily available in standard sizes in many localities they offer advantages for a number of farm service buildings.

Advantages of Pole Frame Construction—

1. Easier construction—poles are set like fence posts, no notching and but little sawing.
2. Faster erection—foundation and framing completed in one operation.

"Stiffness is little affected by such defects as knots, checks, and shake. In light building construction therefore, material of the sound, though knotty grades (of lumber) may be used to good advantage for joists and studs because stiffness is more important than breaking strength in these items."
U.S.D.A. Farmers' Bulletin No. 1756.

3. Saves material—poles replace main framing, no footings, no foundations, no anchor bolts, no reinforcing, and little or no bracing.
4. Poles anchor the building, support the entire framework, and provide adequate strength.
5. Seldom requires ground leveling—girts are leveled on poles.
6. Less cost—construction labor and material reduced.



(D.A.S. Photo)

Pole frame barn under construction. A contract builder and three helpers completed this 54′ x 60′ barn in 371 hours. This picture was taken after 3¾ days' work.

This 54′ x 60′ pole frame barn constructed in September, 1941, cost $1772. It will handle 65 beef cows which is a cost of $27.26 per cow.

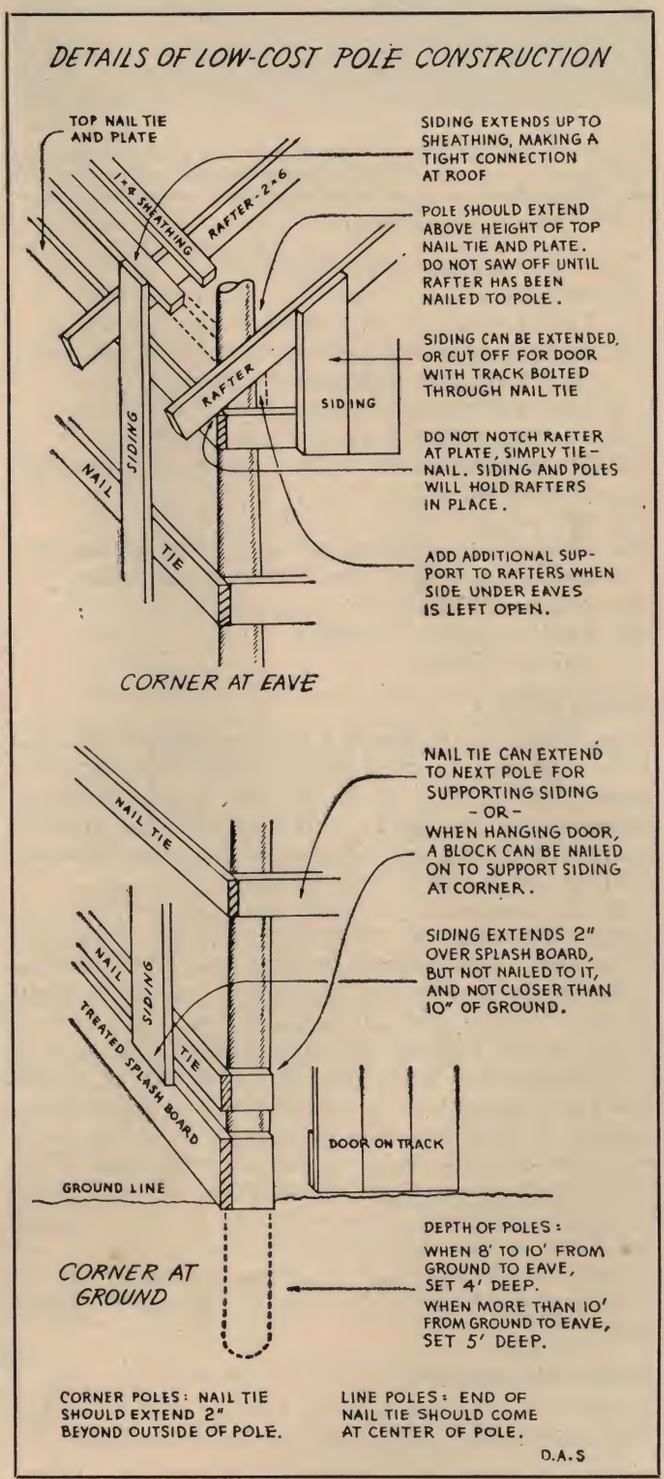
(D.A.S. Photo)

Easily constructed low-cost 2″ x 6″ feeding fence, lag screwed to poles. Wastage of hay is eliminated because cattle stick their heads through the fence and hay dropped remains within the feeding area contrasted to a slatted feeder where cattle pull the hay out and often drop some of it under their feet.

Disadvantages of Pole Frame Construction—

1. Should be constructed on well drained sites to insure dry dirt floors.
2. Generally limited to one-story structures.
3. Sometimes difficult to obtain modern treated poles that are straight and of proper size.

Pole frame construction is as "easy as building a fence." *No notching and but little sawing adds to strength of the building and simplicity of construction.*



Every farmer knows that there is no satisfactory substitute for the combined strength, durability, warmth, and workability that Nature gives to wood.

(D.A.S. Photo)

Note the treated splash boards in contact with the ground. If they ever need replacing it is easy to just knock them off and nail on new ones. The siding ends will not rot when they are 14 to 16 inches off the ground as shown here.

The order of construction should be:

1. Set poles.
2. Level and nail on top nail tie and girt.
3. Nail rafters to each pole. Rafters should rest on top nail tie and girt. (See sketch of details.)
4. Level and nail on bottom nail tie.
5. Nail on center nail ties and splash board.
6. Toe nail remaining rafters in place between poles. (Do not notch.)
7. Saw off top of pole even with top of rafter.
8. Nail on the one board used as sheathing which makes a tight connection between the roof and siding.
9. Nail on siding.
10. Finish nailing on sheathing.
11. Nail on shingles.

Spacing of Poles

Poles within the interior of a barn or livestock shed can be of value for supporting panels for partititions and feed bunks. On the other hand, the poles should not be so numerous that they hinder operations within the structure such as the use of power manure loading equipment which calls for a wide expanse between posts.

Simple open pole frame sheds usually are low in cost and high in "use value," yet the spacing of poles in these structures must be given major consideration. Spans between posts lengthwise of the building should normally be about 12 feet—not less than 10 feet, nor more than 14 feet. Spans for the width of the building can be as much as 24 feet without a center pole, provided there is a gable roof and poles are set 4 to 5 feet in the ground and rafters are tied. A simple roof truss can be made by nailing 1 x 6's criss-cross between the 2 x 6 rafters and rafter ties. When it is desirable to span 26, 28, 30, and 32 feet, there should be center posts with the rafters supported by side braces on the posts, so that the unsupported portion of the 2 x 6 rafters is not over 14 feet. In some instances it may be more desirable to truss the roof to eliminate the center post.

Arch Construction

Arch construction can result in a saving of material and labor, as compared to conventional frame buildings:

Advantages of Arch Roof Construction—

1. Lumber of varying lengths can be used in the arches —4 feet to full arch length.
2. Lower grade lumber can sometimes be used in the arches.
3. Less material in the arches than in studs and rafters.
4. Greatly reduces the amount of paint and labor applying it, as normally only ends are painted.
5. Less maintenance.

Disadvantages of Arch Roof Construction—

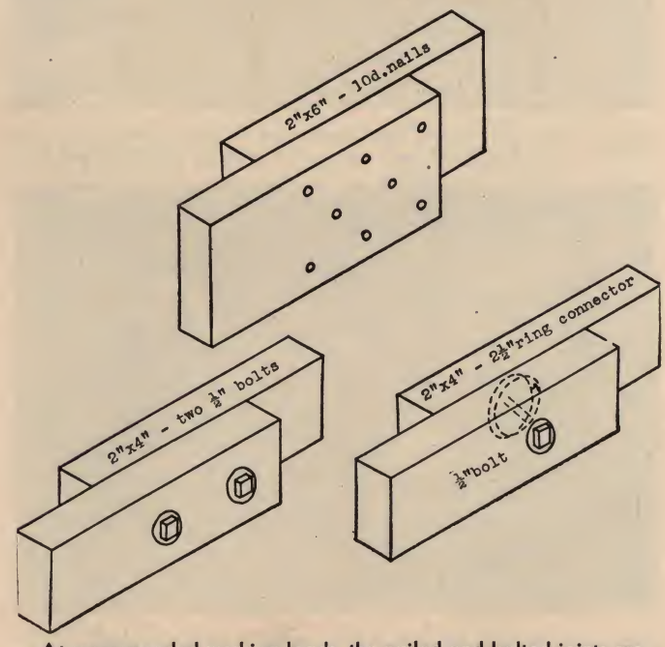
1. It is difficult to put windows along the arched sides.
2. Separate structures must be built for overhead bins.
3. Special attention must be given to bracing of ends.

Bolts—Glue—Timber Connectors

New methods of joining lumber and making full use of its inherent strength can save a great deal of material. Many strength tests made at the Forest Products Laboratory of the United States Department of Agriculture, Madison, Wisconsin, are the authoritative source of strength data on joint devices and timber. Such information may be obtained directly from the Laboratory or from the various lumber manufacturers' associations. Your retail lumber dealer will assist in obtaining this information.

Timber Connectors

There are several types of timber connectors but the split-ring type is the one normally used in farm buildings. It is a metal ring placed between two pieces of wood bolted together. A groove is cut in each piece of wood to tightly hold the ring in place. Ring connectors make it possible to use as much as 80% of the tensile strength of wood whereas under the bolt, rod, and cast iron plate method, only 40 to 60% of the working strength of wood members is utilized.



At recommended working loads, the nailed and bolted joints are about equal in strength. The timber connectored joint is about three times stronger than either the nailed or bolted joint as shown in the above sketch.

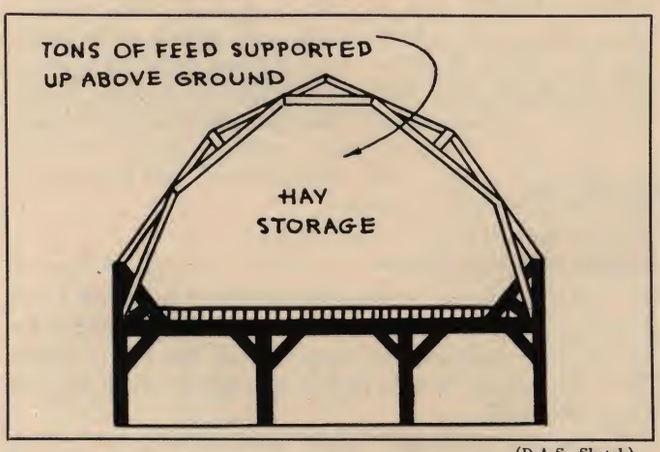
"So little difference in the labor and materials is involved between a rigid and flimsy wall that it seems almost inexcusable to construct a building without wall bracing." Iowa State College Circular No. 127.

Trip-L-Grip Anchors

Trip-L-Grip Anchors add strength to frame joints in farm buildings, thus providing added resistance to high winds and other loads on the structure.

Timber connectors with grooving tools and Trip-L-Grip Anchors can be obtained through Timber Engineering Company, 1319 18th Street, N.W., Washington 6, D. C.

Inside view of a ring connector truss.



(D.A.S. Sketch)

Detailed information on this type of structure can be obtained from retail lumber dealers or by writing to state Agricultural Colleges.

Retail lumber dealers can supply detailed information on timber connector construction.

Single Story—Additional Height

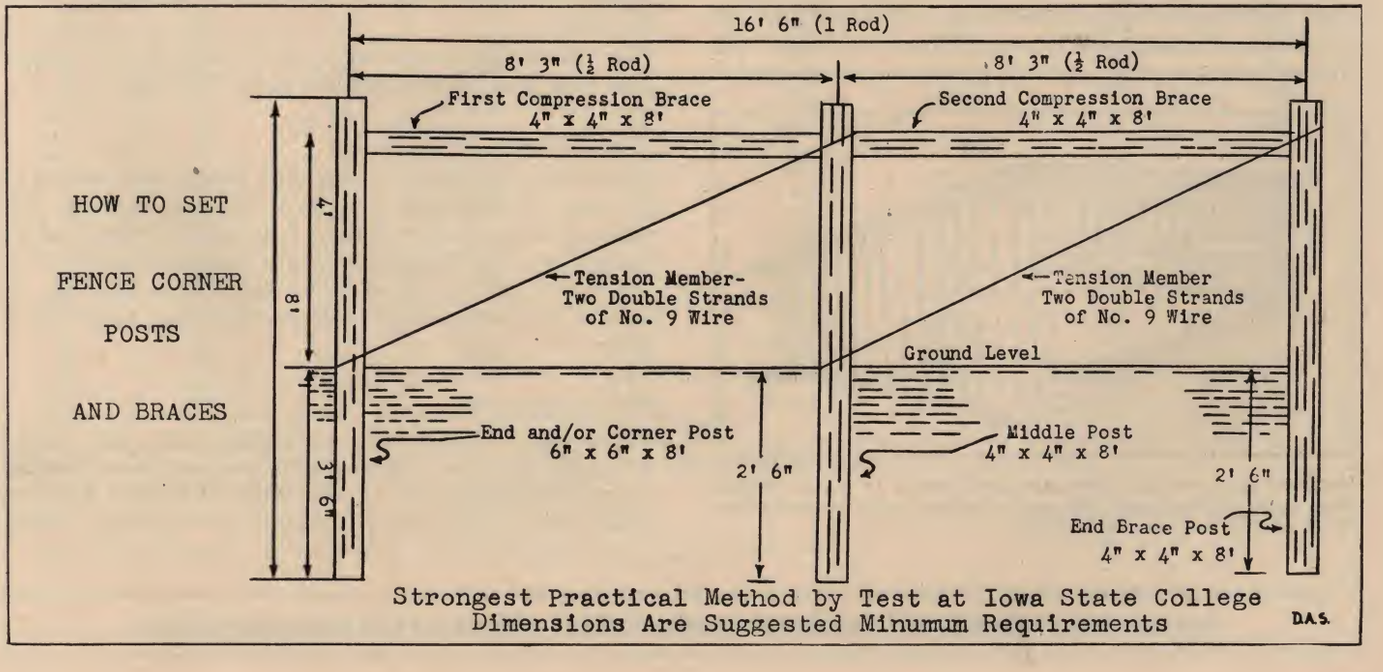
It takes a large amount of strong material to support heavy quantities of feed overhead. The entire structure of the building must be of rigid heavy construction.

Construction Features to Achieve Long Life

Kinds of materials and quality of construction have a bearing on the life of a building. Long life is naturally desirable in a building, provided it is designed for flexibility and versatility of use, and the additional cost of obtaining long life is not too great. Additional life can be often added to a building, however, by certain construction features which do not add materially to cost.

A wise builder can figure out other ways of adding to life with but little addition to cost. Some of the best known ways to achieve long life are:

1. Place foundation well below frost line and add reenforcing to footings.
2. Use materials for each purpose well adapted to that use, as resistance to moisture, decay and insects.
3. Have structure properly braced. Good designs of engineered plans will indicate where bracing is necessary and will avoid unnecessary bracing.
4. Use plenty of nails or other connectors of the correct size.
5. In pole frame construction use poles treated with preservative.
6. Place side sheathing on diagonally. (Increases stiffness seven times.) Use 1 x 6 instead of 1 x 3 roof sheathing.
7. Allow conservative spacing and lap of shingles.
8. Allow no horizontal surfaces to catch moisture.
9. Avoid notching lumber or poles. Support with blocks rather than cutting into adjoining members.
10. Keep siding well above the ground and manure. Use treated lumber for all contacts with the ground.
11. Make window and door openings water-tight by using flashings.



Ventilation Construction Features

Farm building ventilation can be taken care of by the use of open-type buildings involving no construction problems, or by gravity or forced ventilation which requires special structural consideration. A discussion of these methods of providing proper air exchange follows:

Open Sheds and Buildings

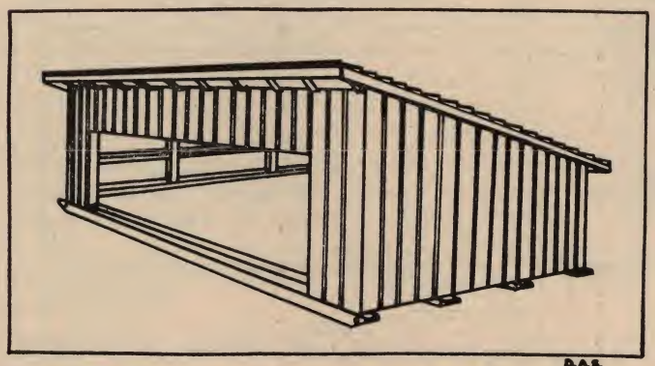
1. It is not necessary to have buildings too tightly constructed. Draft should be restricted but small cracks allowing some exchange of air is actually a good thing in most livestock buildings, especially for cattle, horses, and sheep, where the inside and outside temperatures should be about the same.

2. Where possible, leave the south side of buildings open. Open sheds for dairy cattle are advisable, even in northern climates. Too much emphasis has been placed on warm barns. At Scottsbluffs Station, Nebraska, near the Wyoming line, where temperatures get down to 20 degrees below zero, the high-producing Holstein herd owned by the college stays in an open shed—and *there are no ventilation problems.* In northern climates, however, there should be a windbreak extending south from the west wall a distance equal to one-half to two-thirds the length of the open area. Without this, a hard-driving snow from the northwest may cover more than half the floor area.

3. Where it is not practical to leave the entire front of the building open because of location in extreme northern climates, then a portion of the front should be closed. For small poultry houses, plenty of good fresh air can be provided by keeping a portion of the front of the house covered with coarse burlap. This should not be relied upon entirely. During warm days, windows will need to be opened from the bottom and top in order to furnish sufficient amounts of fresh air.

Gravity Ventilation

There are some buildings now in use and new ones to be constructed, in which either gravity or forced ventilating systems will be desired. Gravity ventilation is a subject within itself and cannot be adequately covered here in the space available. The primary problem of ventilation in tight buildings is that of preventing condensation by the circulation of enough air to remove excess moisture. The method of ventilation used will depend upon the type of building and kind of livestock or poultry sheltered. Some buildings are very difficult to ventilate properly. For such buildings an engineer should be consulted.



D.A.S.

Hogs will not come out of this serviceable shelter on a cold morning "with steam all over them." The space between the rafters at the front is left open for free movement of air.

A difference in temperature between the inside and outside of the building is necessary to make a ventilation system work. Cool air is relatively heavy. As it enters the structure and comes in contact with the livestock or poultry it is warmed. The rise in temperature causes the air to expand so that it occupies more space; thus, it becomes lighter in weight and moves up to give way to cooler, more dense air. The greater the difference between inside and outside temperature, the faster the movement or air exchange. The moisture-carrying capacity of air is greatly increased as it becomes warm. With sufficient exchange of air, excess moisture is eliminated, preventing condensation and wet litter.

Building should be *tightly constructed* and air leaks at doors, windows, walls, floor and hay chutes should be minimized. Often it is necessary to thoroughly *insulate* a building before a gravity ventilation system will work properly. All of this means *greater cost* which should be thoroughly weighed against the simple method of open-type structures.

One Flue System

There should be definite inlets and outlets of sufficient size. Ventilating systems often fail because the air passages are too small. The single outlet flue system, as recommended by Fairbanks and Goodman of Cornell University, is less costly to install than multiple flues and often increases the effectiveness of the system. One flue may be used for barns up to 100 feet.

Outlet at Ceiling or Floor

In "cold buildings," where temperatures are often below freezing, or where there is relatively little difference between inside and outside temperatures, the outlet should be at the ceiling, or high part of the ceiling where the ceiling is not level.

In "warm buildings," where temperatures are seldom below freezing and there is a relatively large difference between inside and outside temperatures, the outlets should be within 12 to 15 inches above the floor.

Flue Size

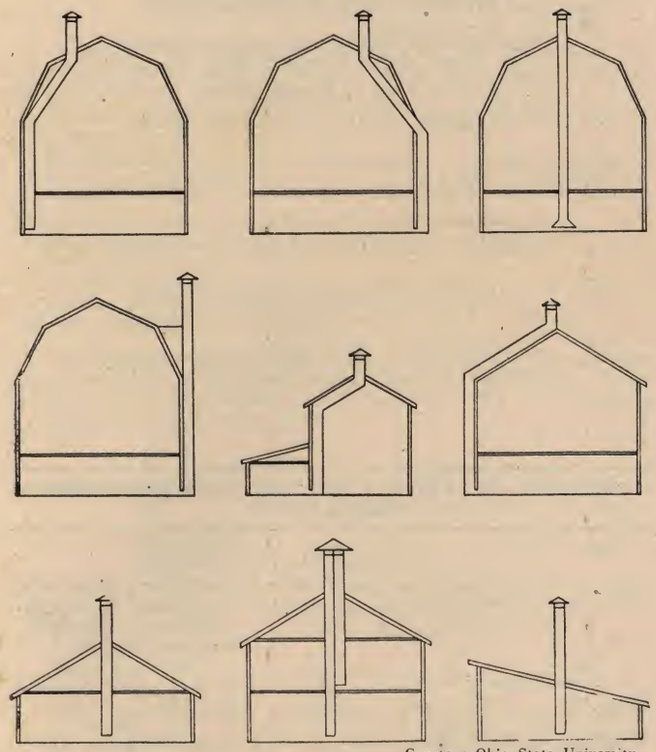
The size of the flue (outlet) is determined by the number and kind of livestock sheltered in the building.

Flue Placement

The outlet flue should be installed where it will be out of the way. For barns it may be at the ends or sides. For multiple-story poultry houses it is usually placed in the center. For "L" shaped structures the flue should be near the middle of one side or at the angle of the building. It should be at least 6 feet, horizontally, from any inlet or door.

Flue Construction

Flue outlets should have no abrupt turns and should be made air-tight. They should be insulated their full length to maintain the temperature difference between inside and outside. Two thicknesses of matched boards



Courtesy Ohio State University

The outlet flue can be placed at any one of many positions, as illustrated by the sketches above. It should rise above the top of the building without sharp bends or horizontal sections.

with asphalt or stout building paper between is satisfactory. There should be no obstruction of any kind within the air ducts.

Flue Head Opening Size

The height of the opening at the flue head should be one-half the width of the flue.

Flue Head Construction

The flue head should be flat and insulated. A simple gable roof may cover it to provide protection.

Inlet Size

Inlets should have an open area of approximately 60 square inches each. The total open area of all inlets should equal the area of the outlet flue.

Inlet Placement

Inlets should be placed evenly around the outside walls. They should be constructed above the snow line in areas of heavy snow. In livestock barns they should be within 12 inches of the ceiling or deflector under the mow floor joists.

Inlets for poultry houses should preferably be placed close to the floor.

Inlet Construction

Inlets should be constructed with baffle plates or other provisions so the incoming cold air does not interfere with the warmer outgoing air, sweep across the floor, or make

HOW TO DETERMINE SIZE OF FLUE

AS RELATED TO KIND AND NUMBER OF LIVESTOCK AND HEIGHT OF BARN

Number of animals kept in one stable or pen*			Cross Section area of flue in square inches needed for various heights between floor and highest part of roof					
Mature Cattle **	*Sows with litters*	*130-lb. pigs*	*20 ft.*** *high sq. in.*	*25 ft. high sq. in.*	*30 ft. high sq. in.*	*35 ft. high sq. in.*	*40 ft. high sq. in.*	*45 ft. high sq. in.*
5	10	25	225	210	200	200	200	200
6	12	30	270	252	234	216	200	200
7	14	35	315	294	273	252	231	224
8	16	40	360	336	312	288	264	256
9	18	45	405	378	351	324	297	288
10	20	50	450	420	390	360	330	320
11	22	55	495	462	429	396	363	352
12	24	60	540	504	468	442	396	384
13	26	65	585	546	507	468	439	416
14	28	70	630	588	546	504	462	448
15	30	75	675	630	585	540	495	480
16	32	80	720	672	624	576	528	512
17	34	85	765	714	883	612	561	544
18	36	90	810	756	702	648	594	576
19	38	95	855	798	741	684	627	608
20	40	100	900	840	780	720	660	640
30	60	150	1,330	1,165	1,055	964	890	835
40	80	200	1,730	1,515	1,370	1,255	1,165	1,100
50	100	250	2,105	1,855	1,660	1,520	1,420	1,335
60	120	300	2,460	2,160	1,940	1,780	1,655	1,562
70	140	350	2,782	2,455	2,205	2,020	1,865	1,775
80	160	400	3,100	2,725	2,455	2,250	2,090	1,965
90	180	450	3,390	2,970	2,670	2,455	2,280	2,155
100	200	500	3,660	3,200	2,870	2,655	2,460	2,325

*For numbers of animals not shown, increase the flue area for a given height in proportion to the increase in numbers over the animals shown.
**Mature cattle plus young stock calculated on the basis of approximately 1,000 pounds equals one mature cow.
***Twenty feet is the minimum height of flue recommended.

Data from Ohio State University, U.S.D.A., Cornell University

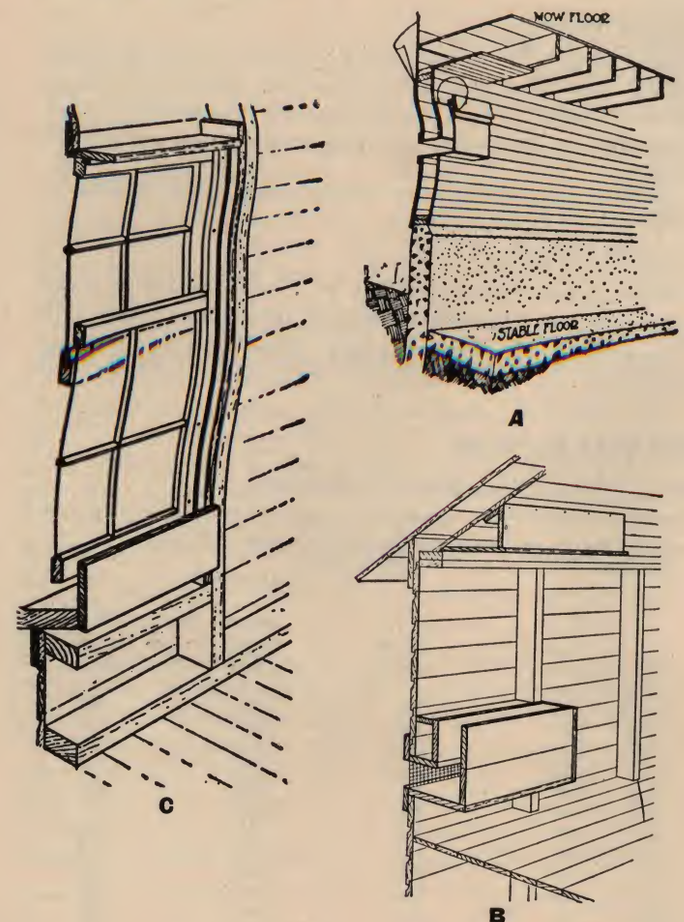
For additional data on flue sizes consult Cornell Extension Bulletins Nos. 151 and 315.

drafts. They should have control doors one inch narrower than the opening, or constructed so they do not completely close the opening.

Forced Ventilation

The outlet for electric fans, used in forced ventilation, should vary according to the type of building. For "cold buildings" the fan should be placed to discharge close to the ceiling and for "warm buildings" close to the floor. The fan should be on the outside of the building away from the prevailing winter wind, and operated continuously both night and day.

Good fundamental reference material can be found in the bulletins listed at the top of the next column, as well as many State Agricultural College publications.



Courtesy Cornell University

A. An Inlet For a Ceiled or an Unceiled Stable. The inlet should not open into the space between two studs unless there are headers at top and bottom of the space. It should be built as indicated. A 2-foot square flat horizontal surface should be constructed above the intake on the underside of the joists to deflect the incoming air. The top of the inlet flue should be 12 inches below the bottom of this deflector.

B. Wind Baffle for Use Over Inlet Near a Sloping Ceiling. Wind on striking a sloping ceiling has a tendency to follow the ceiling and to blow downward on the opposite side of the house. This baffle helps to check it. Screens can be placed across the openings on a slant to prevent birds from roosting on the inlets.

C. Cross Section of Window Inlet. The window sill extends clear to the baffle board so that wind cannot blow down to nor across the floor. A wire-netting guard may be placed over the inlet to prevent the birds from roosting on it.

"Principles of Dairy Barn Ventilation"
By—M. A. R. Kelley
U.S. Dept. Agri. Farmers Bul. No. 1393
Superintendent of Documents
Washington, D. C.....Price 5 cents

"Dairy-Stable Ventilation"
By—F. L. Fairbanks and A. M. Goodman
Extension Bul. No. 151
Cornell University, Ithaca, New York

"The Ventilation of Poultry Laying Houses"
By—F. L. Fairbanks and A. M. Goodman
Extension Bul. No. 315
Cornell University, Ithaca, New York

SIZES OF ELECTRIC FANS FOR POULTRY-HOUSE VENTILATION

Floor area (A)	*Capacity of fan required* (B)	*Approximate diameter of fan** (C)	*Approximate current consumption for one month** (D)	*Inlets each 60 sq. in. in area* (E)
Sq. ft.	Cu. ft. per min.	Inches	Kw. Hrs.	No.
400	125	6	30	3
800	250	6	40	7
1,200	375	8	48	10
1,600	500	8	55	13
2,000	625	12	61	17
2,400	750	12	66	20
2,800	875	12 to 16	70	23

*The diameter and current consumption of fans of different capacities vary greatly, depending on the speed and on the design of the blades. The values in the C and D columns are offered merely to give some indication of the size and the probable cost of operating fans.

Cornell Extension Bulletin 315

SIZES OF ELECTRIC FANS FOR DAIRY STABLE VENTILATION SYSTEMS

Mature Cattle (A)	*Capacity of fan required* (B)	*Approximate diameter of fan** (C)	*Approximate current consumption for one month** (D)	*Inlets each 60 sq. in. in area* (E)
Number	Cu. ft. per min.	Inches	Kw. Hrs.	Number
5 to 9	420	8	54	2
10 to 14	720	12	66	4
15 to 19	1,000	12 to 16	72	5
20 to 24	1,300	16	94	6
25 to 29	1,600	16 to 18	113	8
30 to 39	2,100	18	139	10
40 to 49	2,700	20 to 24	164	13
50 to 59	3,300	20 to 24	184	16
60 to 69	3,900	24 to 26	205	19
70 to 79	4,500	26 to 30	223	21
80 to 89	5,100	26 to 30	233	24
90 to 100	5,800	30 to 32	248	27

*The diameter and current consumption of fans of different capacities vary greatly, depending on the speed and on the number and design of the blades. The values in columns C and D are offered merely to give some indication of the size and probable cost of operation.

Cornell Extension Bulletin 151

"Well-constructed buildings seldom suffer serious damage even in the worst windstorms. Bracing to provide reasonable security against wind damage costs little and in many cases may be applied to existing buildings." U.S.D.A. Leaflet No. 87.

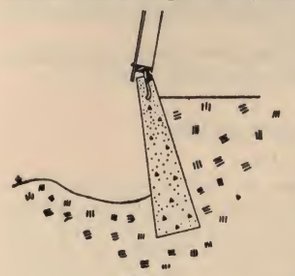
FARM BUILDING REPAIR

FOUNDATION FAILURE AND REPAIR

In construction or repair of foundations the following practices will pay large dividends in the long run.

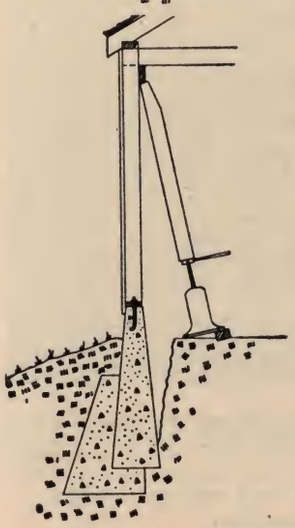
1. Use not to exceed 6 gallons of water per sack of cement in making concrete for foundations.
2. Use only clean materials.
3. Reinforce foundation walls near top of walls and around the corners.
4. Use forms on both sides of the wall for best results.
5. Place foundation wall on a broad footing. (A width of 12 to 16 inches is usually sufficient.)
6. Set bolts in concrete to hold the sills in place.
7. Provide good drainage for roof water.
8. Place footing below frost line.

Foundation Wall Tilted Out.— In the first drawing below is shown a common type of foundation failure. Proper care of the roof drainage would probably have prevented it. Wet soil has about one-half the strength of dry soil.



Causes of Failure

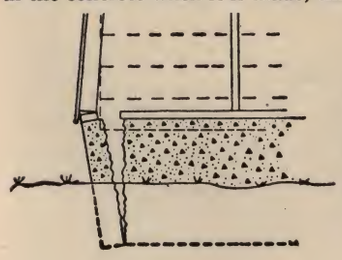
1. Soil beside and under the foundations failed.
2. Pressure was developed inside of foundation wall.
3. Livestock may have crowded against the wall.
4. Footing was too small.



Steps in Repairing

1. Jack up one section of the building at a time. Raise a little higher than the normal position.
2. Straighten foundation wall and pour footing as shown.
3. Allow time for curing and then lower the section into place.
4. Provide spouting or grade up around building to secure drainage.
5. A tile drain covered with gravel may be used in lieu of spouting.

Foundation Split at Corner.—Concrete is ten times stronger in compression than it is in tension. By casting steel rods in the concrete when it is made, this weakness is overcome.

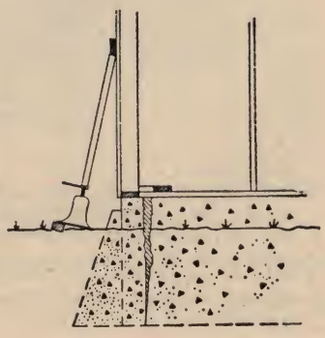


Causes of Failure

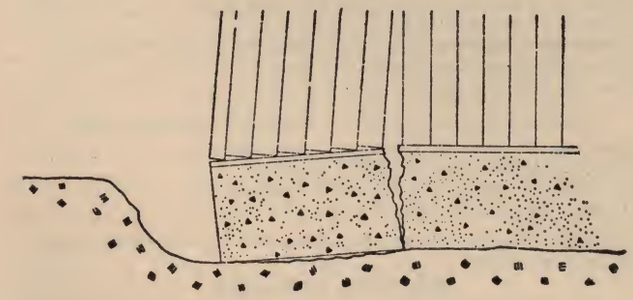
1. Pressure on inside of both walls causes extra load on foundation at corner.
2. Lack of reinforcement at corners.
3. Excess water outside the foundation at corner.

Steps in Repairing

1. Chip away about 2 inches of the wall at break to allow end foundation to come back into place.
2. Jack wall and foundation back into correct place.
3. Build pilaster to hold wall in place.
4. Nail tie across corner to hold sills in place.
5. Fill opening in wall.



Foundation Undermined — Lack of care of roof drainage is the cause of many failures in farm buildings. Spouting connected with surface gutters of concrete will remove this water safely.

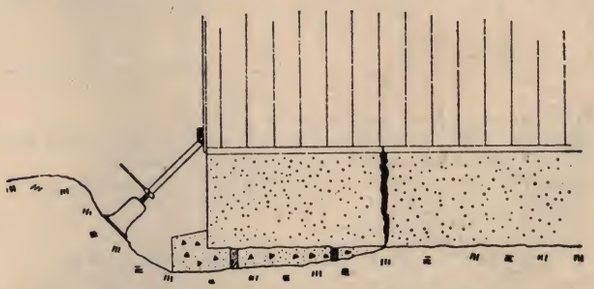


Causes of Failure

1. Erosion or a hog wallow caused by lack of drainage.
2. Lack of support under footing at corner.
3. Lack of reinforcement in the top of the wall.

Steps in Repairing

1. Dig under foundation at one point to provide room for jack.
2. Chip off about 2 inches of the wall at the break to aid in getting it back into place.
3. Lift foundation and building back into place.
4. Support on brick pillars as shown.
5. Pour a concrete footing, tamping it well under the old wall.



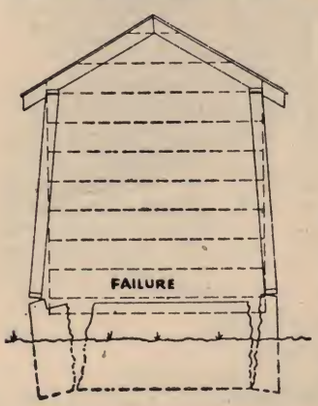
If a foundation is undermined between supports, the reinforcement is needed in the footing or at the bottom of the beam.

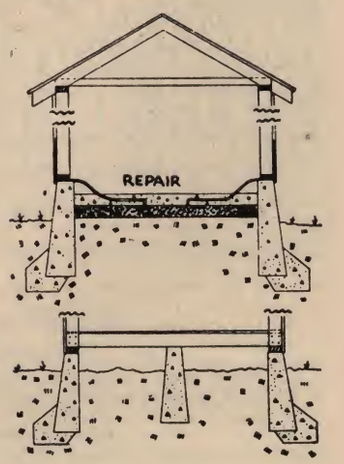
New foundations should be reinforced near the top, the bottom, and around the corners to be safe for all conditions.

Spreading of Walls — Either wood or concrete

Causes of Failure

1. Pressure of grain.
2. Lack of adequate cross ties.
3. Lack of reinforcement in foundation and floor.
4. Burrowing rodents.
5. Moisture in grain keeps lumber damp.
6. Livestock damage lumber attempting to get to grain.





Repairing with Concrete Floor on Gravel or Cinder Fill*

1. Jack up one side of building and straighten.
2. Put foundation back in correct position.
3. Grout in a footing to hold foundation in place.
4. Repeat for opposite side.
5. Break out section of floor to hold anchors (spaced 6 feet).
6. Repair floor and cast anchors in place.
7. Re-nail siding as needed.

Steps in Repairing (Wood floor on concrete walls)

1. Jack up one side of building and straighten.
2. Put foundation back in correct position.
3. Grout in a footing to hold foundation in place.
4. Repeat for opposite side.

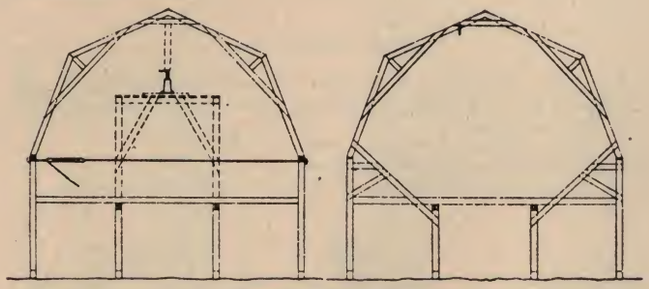
*If cinders are used it may be advisable to place roofing paper under the cinders.

ROOFING FAILURES

Sagging Roof.—This is another type of failure that grows rapidly worse unless promptly repaired.

Causes of Failure

1. Pressure of hay on frame on sidewalls.
2. Lack of stiffness in plate.
3. Incorrect bracing.

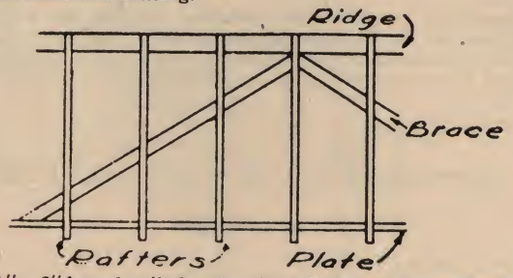


Steps in Repairing

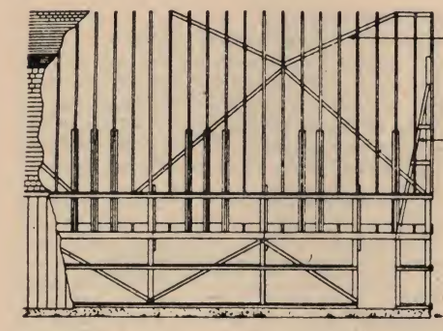
1. Build up a platform from which to lift at center.
2. Attach a cable and block to pull side walls in at the plate level.
3. Apply both at the same time to straighten roof line.
4. Install side braces made of two 2 x 8s at intervals of 8, 10, or 12 feet.
5. Re-nail all braces affected.

BRACING THE ROOF ABOVE THE PLATE

Steep roofs extend to a considerable height above the plate and require some end bracing.



A 1″ x 6″ board nailed under the rafters may be used on a straight gable roof.



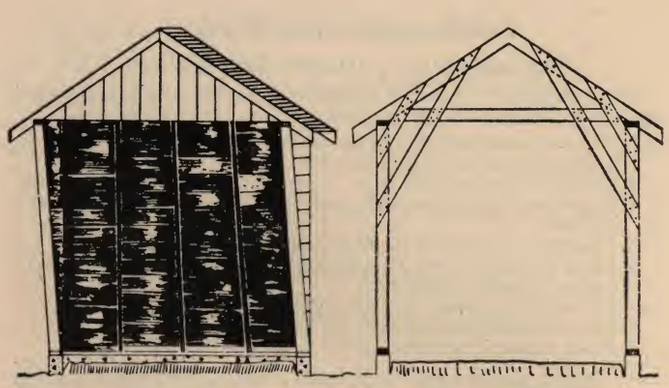
2″ x 4″ pieces nailed in between rafters as shown are usedon roofs with obstructions on under side as in the gambrel roof.

FAILURE IN BRACING

Causes of Failures

1. Doors are open a great deal and wind causes a strain.
2. There is no width of wall to give stability.
3. Weight of doors causes strain.

MISSOURI AGRICULTURAL EXP. STA. From circular 279.



Single garage without bracing. Bracing inside the building.

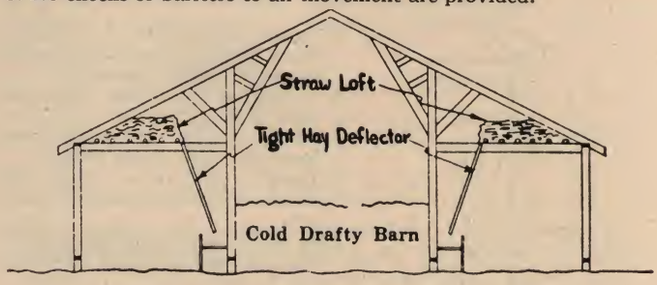
Steps in Repairing

1. Straighten building until sides are plumb.
2. Nail short tie to hold rafter on plate.
3. Nail brace to rafter, joist and studding. Set brace as far down as possible without interfering with use of door.
4. Nail and brace rear end if needed.

FAILURE IN VENTILATION

Causes of Failure

1. Heat produced by stock is dissipated into hay storage space.
2. If shed doors are open, drafts through the entire building are sure to result.
3. No checks or barriers to air movement are provided.



How to Repair Ventilation Failure

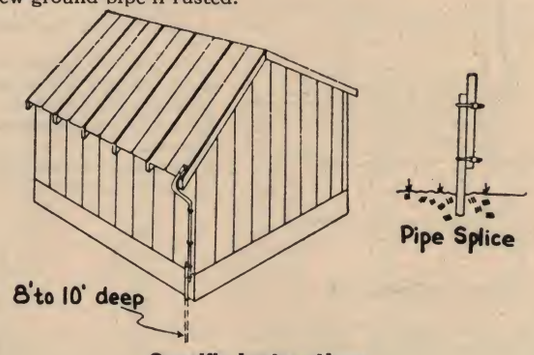
1. Build solid deflector over mangers.
2. Place poles one foot apart on ceiling ties.
3. Cover poles with chicken netting and straw.
4. Add extra hay or straw to mangers on extremely cold, windy nights to prevent drafts.

Hay can still be fed direct to mangers but cross drafts will be checked. Air movement through straw loft will give adequate ventilation.

LIGHTNING PROTECTION FOR METAL ROOFS

General Information

1. A metal roof should be grounded for safety.
2. Ground opposite corners of the roof. If building is over 200 feet in circumference, ground four corners.
3. Renew ground pipe if rusted.



Specific Instructions

1. Flatten ½ inch pipe so as to secure 3 square inches of contact with metal roof.
2. Drill to take bolts for fastening to roof.
3. Bend to fit against building as shown. Avoid sharp turns.
4. Drive or set ground pipe deep enough to reach moist soil. If rock is encountered, lay in a horizontal trench.
5. Splice to upper pipe with clamps or "U" bolts.
6. Cupolas or raised parts on roof should have points. These can be grounded to the metal roof.

BEFORE

This large old house needed not only repair but modernizing. The old attached shed in the foreground was "excess baggage."

AFTER

A bedroom was made into a large screened in porch. Sink and cupboards were placed in the kitchen and a large pantry was made into a bathroom. The old Pennsylvania gutters were removed and replaced with neat appearing wood gutters.

The feed storage capacity of the old horse barn is made usable by the addition of a low-cost cattle shed. Here it is being used for hay storage until cattle are brought in for winter feeding.

Remodeling Farm Buildings

Modernizing our farm homes is essential in order to make them attractive, liveable, and efficient.

There are many knotty problems in remodeling obsolete service buildings. Perhaps the greatest one is that of rebuilding our out-dated horse barns into productive and profit-making structures.

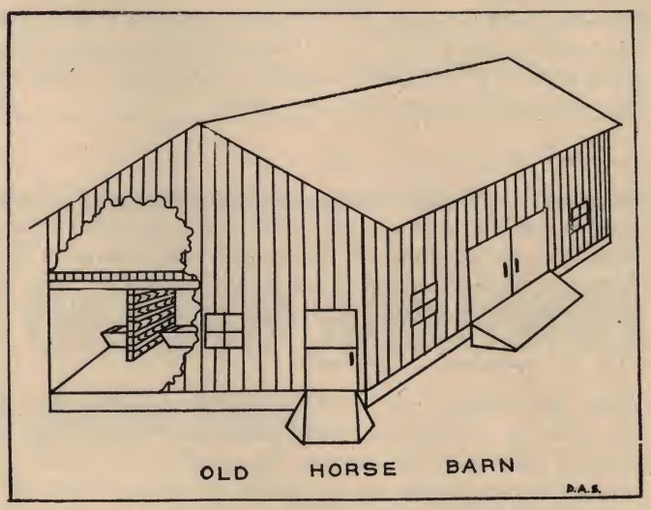
There are two principal methods of remodeling. The first is to leave the main structure intact and simply take out and replace or rearrange the interior equipment to fit the new enterprise—in other words, modernize with productive "furniture." The second method is to completely strip the interior so the structure can be mainly used for feed storage and then build on to house the livestock.

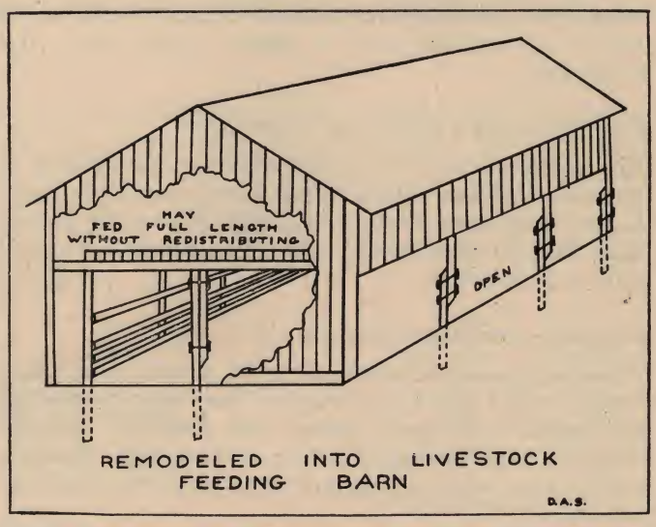
The following sketches illustrate these two methods as they apply to remodeling a horse barn into a livestock feeding barn.

FIRST METHOD—CHANGING THE INTERIOR

Step one—take out the interior equipment

The horse stalls, mangers, and floors are normally removed. If there is a good grain bin it may be left for the storage of grain, protein supplement, and minerals.





Fine architectural styles feature wood construction. Plan to build with wood to have the warmth, individuality and personality you want in your home.

The oldest homes in America were built with wood. The newest homes in America are built with wood.

Step two—reinforce the framing

This step is often not necessary unless the floor and foundation have been altered. Even then, the job is usually not very difficult where treated poles are used. They can be set 5 to 6 feet deep and bolted to the framing to make it rigid and strong. It is important to set the poles deep. A pole set 5 feet deep is six times stronger than one set 2 feet deep, in terms of its resistance to side pressure.

Step three—add labor-saving features

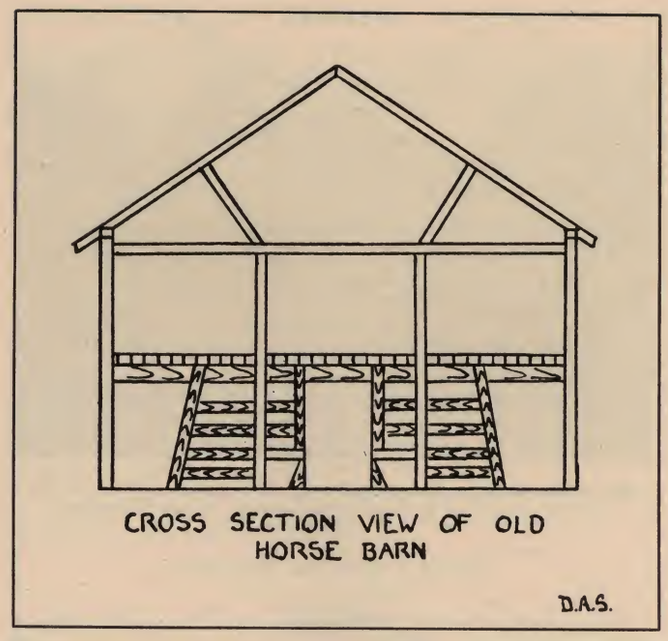
For livestock feeding barn a side can be removed to eliminate doors and provide ventilation.

A hay-feeding fence can be built along the back side so hay can be fed the full length of the barn without redistributing.

A loft opening should be provided at the front center so straw can go directly to the bedded area.

For poultry houses convenient stairways, windows, feed storage area, nests, litter chutes, ventilators, and watering equipment should be added.

See Chapter 5 for other suggested ideas.

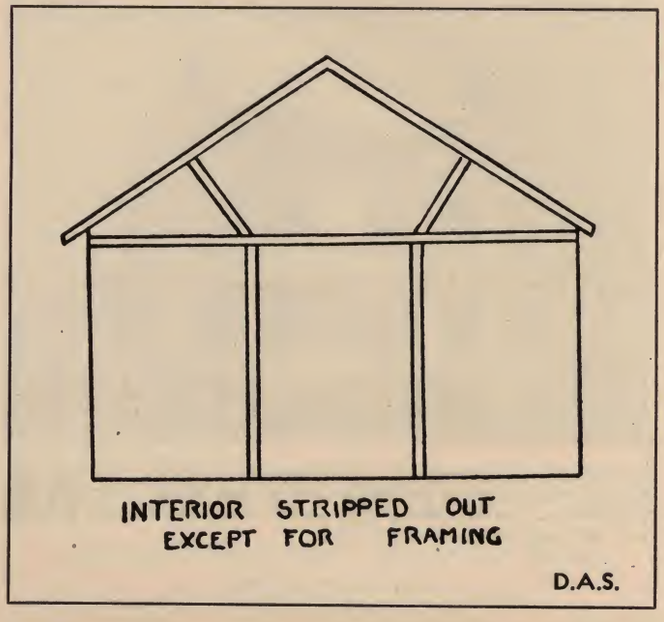


SECOND METHOD—STRIPPING AND BUILDING ADDITIONS

Obsolete buildings such as old horse barns can be made into profit making structures. Remodeling jobs are usually quite easy to do after the method is worked out. Most of the work can be done with farm labor.

Step one—strip out the interior

Remove the loft floor, stalls, feed mangers, and bins not needed. Often there are high sills with old wood floors supported off the ground. Usually it is best to remove the floor and cross sills. Sometimes it is necessary to make a dirt fill when the ground is sloping.



Step two—reinforce the framing

After the interior has been stripped out, the framing has nothing to help hold it in place and make it rigid. Treated poles set 5 to 6 feet in the ground and extending to the rafter framing can be bolted to the old members and will make the entire building solid and substantial. Where there are high sills, poles set along the walls can be bolted on to hold them in place—quickly done and economical.

Step three—add a shed to one or both sides

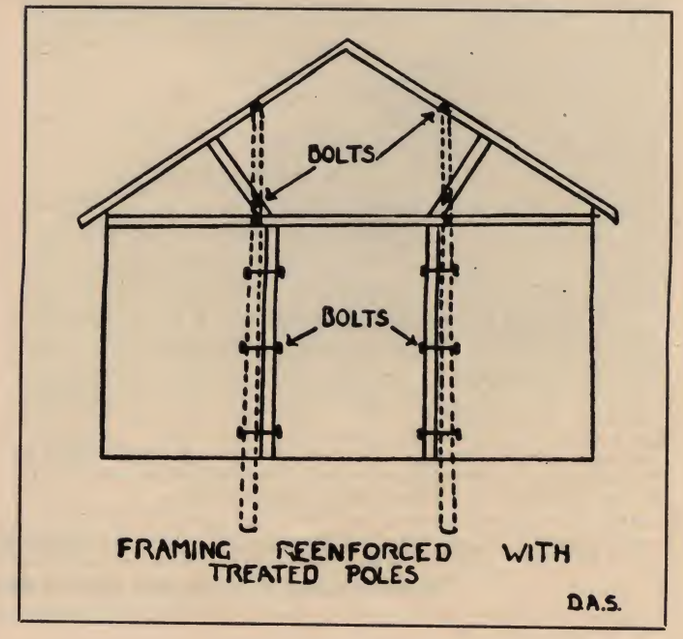
The addition should be of such size that the number of livestock balances with the feed storage capacity. Most barns are of such width and height that sheds 16 feet wide are the most serviceable. This requires 2″ x 6″ rafters, 20 feet long.

Step four—add labor-saving features

Feed troughs may be placed along the outside walls. Bins can be added above the troughs. They may be used as self-feeders or for grain storage with manually operated doors for hand-feeding directly into the trough. The bins can be filled with a blower or from either the inside or outside.

A simple hay feeding fence, allowing livestock to stick their heads directly into the hay storage area, avoids waste and saves construction cost and labor.

For baled or chopped hay, 10 or 12 foot doors may be



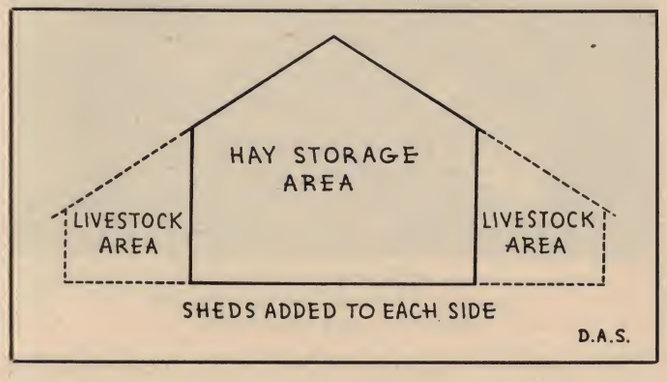
placed at ground level at each end making it possible to drive right into the hay storage area.

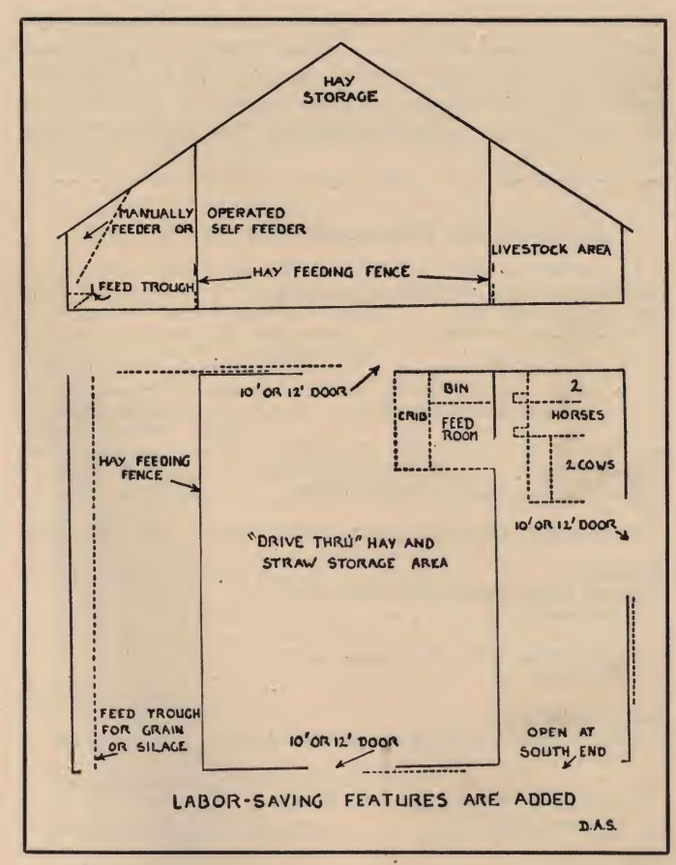
If there is a south or east exposure the livestock shed doors may be left off which will result in healthier livestock, less cost and maintenance. The windward side should be provided with large drive-through doors to accommodate tractor, spreader, and hay frames.

A portion of the shed can be used for a team or a few cows. The original bin and feed room may be left in the barn or built in where needed.

Head clearance in the shed should be not less than 8 feet and preferably 9 or 10 feet so power manure loaders can be used.

(See Chapter 5 for other ideas.)





CHAPTER 7

EFFICIENT LAYOUT OF FARM BUILDINGS CONSERVES SPACE AND TIME

Good farm management necessitates an efficient layout of farm buildings that conserves space and time. Seldom an entire farmstead can be laid out at one time as most farms already have buildings on them which will influence the location of additional buildings. However, a farmstead plan should be established and any new buildings, fences, lots, trees, or orchards should be fitted into this plan.

Farmstead layout involves two problems: first, type of operation and location of the building site on the farm; and, second, location and arrangement of individual buildings within the site.

Location and Arrangement of Buildings

Farm buildings should be so located that they will minimize walking distances and so arranged that the greatest amount of work will be accomplished with the least amount of labor. For the country as a whole, approximately *50 to 60 per cent of a farm operator's time is spent in and around the buildings.* For the average livestock farmer in Minnesota the time is increased to *73 per cent,* as follows:

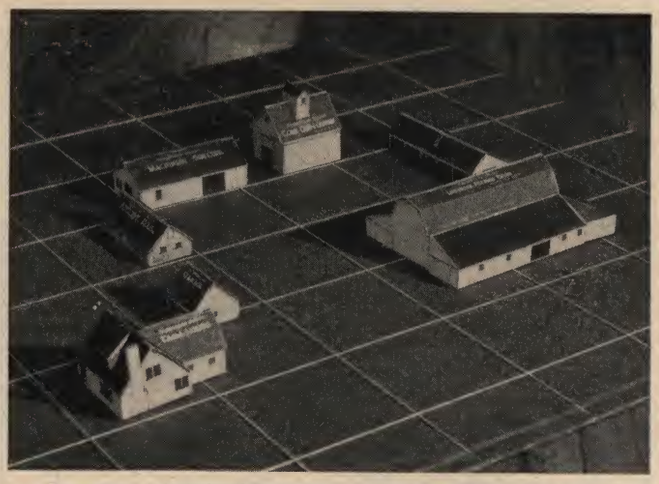
	Total Hours Per Year	*Hours on Farmstead*
Livestock labor	4,078	4,078
Crop labor	1,826	365
Miscellaneous labor	812	441
Total labor on farm	6,716	4,884
Per cent spent on farmstead		73

Data from University of Minnesota

The general availability of wood, its exceptionally high strength for its weight, its ease of working will continue to maintain and to expand its utility and use.

In general, the barn, machine shed, granary and other service buildings should be located around a central court and so arranged that most of them can be seen from the house. The court should be large enough to provide space for turning and parking machinery. The larger the court, however, the more steps are required to do chores, so distances should be kept within the limits recommended.

Farmstead arrangement involves individual problems of wind direction, slope, drainage, and the relation of buildings to fields and roads. Thus the best plan may be somewhat different on each farm. The University of Illinois, College of Agriculture, has devised a set of building models for use in studying various arrangements for convenience, appearance, and efficiency.



Department of Agricultural Engineering, University of Illinois, Urbana, Illinois

Location of buildings can be efficiently planned by using these models.

The miniature buildings shown in the picture are the original blueprinted models developed by the University of Illinois, College of Agriculture. The models are printed on cardboard, cut and creased, so they can be folded and held in shape with paper clips or glue. These models will be useful in working out farm building arrangements.

In planning the location of buildings within the farmstead, consider the points listed on the following check sheets.

Locating the Farmstead Site on the Farm

The following table indicates the various factors involved in farmstead locating and will serve as a guide in checking the desirability of various sites.

Factors to Consider	*Check (✓) Column*		
	Good	*In Between*	*Undesirable*
Topography			
Good—High, level, no abrupt slopes			
Undesirable—Low or on abrupt slope			
Drainage			
Good—High, nearly level, good outlets. Dry lots			
Undesirable—Low, flat, poor outlet. Wet lots			
Water Supply			
Good—Good spring and easy to obtain wells			
Undesirable—No surface water in area of questionable wells			
Soil			
Good—Porous, dries quickly for lots; loose, friable, productive for garden			
Undesirable—No suitable garden soil near house			
Fields			
Good—All close and easy to reach			
Undesirable—all long distance			
Road			
Good—Adjacent to good surfaced road			
Undesirable—unimproved road			
View			
Good—Long range scenic view			
Undesirable—unsightly or restricted view			
Sun and Wind Exposure			
Good—Buildings face road to the south or east			
Undesirable—Buildings face road to the north or west			
Electric			
Good—On power line			
Undesirable—No electric service			
School and Churches			
Good—On bus line, or close to school			
Undesirable—Inconvenient to school and church			
Telephone			
Good—On well maintained line			
Undesirable—No phone			
TOTALS Good			
In Between			
Undesirable			

Building Location Within Farmstead

CHECK SHEET

The following factors to be considered under the various buildings are desirable and should be followed when possible.	*Good*	*Fair*	*Poor*
House should:			
1. Command view of other buildings			
2. Be easily accessible			
3. Be set so visitors can go to either front or back door, but first invitation should be to front door			
4. Be located to make maximum use of sunlight			
5. Be at least 100 feet from road except in heavy snow areas where it may be less, and when on a heavily traveled road 150 feet is preferable			
6. Have yard adaptable to attractive landscaping			
Barn should:			
1. Be within 140 feet to 200 feet from house			
2. Have main entrance and hay door on open court			

(Continued on next page)

Building Location Within Farmstead—(Continued)

CHECK SHEET—Continued

The following factors to be considered under the various buildings are desirable and should be followed when possible.	Good	Fair	Poor
Barn should: (continued)			
3. Be close enough to granary to blow feed over from it			
4. Be close to cultivated fields			
5. Have livestock lot readily accessible to pasture			
6. Be accessible to good water supply			
*Hog House** should:			
1. Be not closer than 200 feet from the home and not in the direction of prevailing winds			
2. Have one end on court			
3. Be close to corn crib for feeding out of it			
4. Be adjacent to cattle lot			
5. Be accessible to good water supply			
* Portable hog structures are preferable. It is well to provide a place within the farmstead where the structures can be moved for winter shelter, close and convenient for feeding.			
Poultry House should:			
1. Be within 100 feet from house unless a major enterprise, then keep away from house			
2. Be located so prevailing winds blow odors away from farm house			
3. Should be on line of travel with work between house and other buildings			
4. Be arranged for double yarding—alternate with garden each year			
5. Be arranged so caretaker can enter the house without passing through the poultry yard			
6. Face south			
7. Be so placed that rearing area of chicks is on opposite side			
8. Be accessible to good water supply			
Corn and *Grain Storage* should:			
1. Be close to largest grain-consuming enterprise			
2. Be adjacent to both major and secondary enterprise such as connected to cattle and hog-feeding lots			
3. Have plenty of space on one side for single cribs and granaries and through the center and around one side for double granaries			

The following factors to be considered under the various buildings are desirable and should be followed when possible.	Good	Fair	Poor
4. Be accessible from the fields			
Machine Storage and *Shop* should:			
1. Be at one side of the central court			
2. Be located so equipment can be driven through and around storage area			
3. Have open storage protected by shop, other buildings, or trees from driving rains and snow			
4. Be accessible to fields			
5. Be in line of travel between house and other buildings			
Garage should:			
1. Be close to or attached to house			
2. Be located so snow will not drift in front			
3. Be reasonably close to shop			
Silo should:			
1. Be close for convenient feeding in either barn or lots			
2. Be arranged so ensilage goes directly into feed bunk, wagon or silage cart for feeding			
3. Have space around it for equipment at filling time			
Milk House should:			
1. Be immediately adjacent to barn or milking room			
2. Be centrally located to milking area of a stanchion barn			
3. Have shortest passageway allowable by local milk ordinance			
4. Be so located that milk truck can drive directly to and from it			
5. Be accessible to good water supply			
Sheep Shed should:			
1. Be within clear view of house and preferably not over 200 feet away			
2. Be adjacent to pasture where possible			
3. Be accessible to good water supply			

Economy of construction does not always mean "pinching pennies." Your retail dealer can refer you to an architect or engineer for advice on economical construction of a magnitude which warrants such expert consultation.

How to Line up Buildings

Buildings should usually be set "square with the world" and at right angles with each other. This produces logical appearance and allows neat and orderly arrangement of lot fences and gates. Care should be taken in laying out foundations to see that corners are square.

To square the corners fix one side of the proposed building. With this as a base, locate the other corner posts by using the 6-, 8-, and 10-foot combination method.

A triangle whose sides are 6, 8, and 10 feet long, respectively, contains a right angle opposite the diagonal side. After all corners are laid out a final check should be made by determining that the distance between both pairs of diagonal corners is the same.

Locating and Planning Windbreaks

A well worked-out farm plan for northern climates should include a windbreak. This added protection from severe winds and snowdrifts will accomplish the following with respect to farm buildings:

1. Reduce extremes of temperatures.
2. Allow greater use of open sheds.
3. Reduce the need for insulation or make it more effective.
4. Reduce damage by strong winds, especially to doors and windows.
5. Reduce exposure and add to life of shingles and siding.
6. Reduce work and improve workability around buildings which increases the effectiveness of labor.

The following principles should be followed to establish a good windbreak:

1. Extend across north and west sides of farmstead, and in far northern areas, around northeast and southwest corners.
2. Allow 100 feet for width.
3. Land should be cultivated before and while trees are growing.
4. Plant 500 to 1000 trees and shrubs per acre.
5. Use a variety of species, both deciduous and evergreen.
6. Evergreen transplants should be 2 or 3 years old; deciduous trees at least $^{3}/_{16}$" in diameter at root collar.
7. Plant 6 to 10 rows, 10 to 16 feet apart, depending on size of trees when mature.
8. Space trees 6 to 12 feet apart, depending on their mature size.
9. Plant high-growing trees in middle rows and low ones on outside.
10. Do not allow tree roots to dry out during transplanting.
11. Protect young trees from livestock and rodents.

Information on species adapted to particular localities and more detailed instructions can be obtained from County Agricultural Agents and publications such as South Dakota Ext. Cir. No. 397—"Planting Windbreaks."

CHAPTER 8

FARM HOMES FOR A "HEAP OF LIVING"

Designing the farm home is the most important single item in farmstead and farm building planning. There are more factors involved for consideration, and individual preferences are of greater influence.

This chapter will be devoted to the factors to be kept in mind in selecting plans for new homes.

Functions of the Farm Home

The functions of a farm house differ from those of city homes in four major respects:

1. It is the headquarters or office of the farm business, as well as a home.
2. It serves as a place to sort, grade, and process farm products for sale and home use.
3. It usually must provide for some of its own utilities such as water and sewerage.
4. It must more nearly provide for all requirements of the family, particularly recreational. In other words, it is "lived in" more.

For these reasons there are three important structural requirements for a farm house which should by all means be observed:

1. The front entrance should face the driveway instead of the highway, so that visitors are encouraged to call there instead of at the rear entrance.
2. The plan should provide a center rear hall which leads directly into every room, without having to go through kitchen, dining room, or living room.

"A wood house will last as long as its owner wants it to last, provided he gives it reasonable care." U.S. Forest Service, Forest Products Laboratory.

3. A work room for cleaning, canning, and freezing fruits and vegetables and other such work should be provided with access direct to the kitchen and to outdoors. (See floor plan in Chapter 4 under "Processing Farm Products.")

Features of Farm Homes

Features that should be considered in a farm home are as follows:

General:

1. A continuous foundation wall around all sides of house.
2. Dormers and valleys in roofs should be avoided and slope should be not less than ¼ pitch for shingles.
3. No ceiling should be less than 7½ feet.
4. At least one bedroom should be on the ground floor.
5. Kitchen window commanding a view of entrance drive and also most of buildings on service court.
6. Both front and rear doors with weather protection over them.
7. Central heating is highly desirable.
8. Running water and sewerage.
9. Easy to climb stairs with handrails.
10. Insulation—at least under roof.
11. Window space not less than 15% of floor area and all windows and doors screened.
12. Storm sash and weather stripping in cold climates.
13. Electric wiring including wall switches at doors and appliance outlets in every room.
14. Storage for one to six months fuel supply in or near house.
15. Food storage space of 24 square feet (approximately 6 to 8 square feet per person) in or near house.
16. Shower bath in work room or basement and a toilet and lavatory on every floor.
17. Family recreational space in addition to living room, such as a game room in basement
18. Liberal space especially in closets.
19. All chimneys built from foundation wall or ground and not on brackets.

Living Room

1. Floor space guide—Minimum, 150 sq. ft.; 210 sq. ft. if dining room is included.
2. View of entrance drive or highway and as much of central court as possible.
3. Connected to or easily accessible to front entrance and to rear entrance through center hall. Entrance hall or vestibule most important in cold climates.

Dining Room

1. Dining room optional—preferably combined with living room or kitchen.
2. Floor space guide—Minimum, 120 sq. ft.
3. Accessible from rear entrance through central hall without going through either kitchen or living room.

Kitchen

1. Floor space guide—Minimum, 84 sq. ft.; if combined with dining room—144 sq. ft.; minimum width—9 ft. Small floor area is desirable if separate workroom is provided for canning and other processing.
2. Fan ventilator.
3. Sink 16″ to 20″ with at least 20″ x 36″ work ledge on either side.
4. Drawers and shelves below work surface and shelves above.
5. Sink under windows. Cupboard with shelves above providing storage directly from drying tray.
6. Cleaning equipment closet—3′ wide by 18″ deep. (Not necessarily in kitchen.)

Bedrooms

1. Practical minimum space—120 sq. ft.; closet—3′ wide by 22″ deep.
2. Separate rooms for boys, girls, and parents.
3. Space and facilities for individual hobbies. Should be "individual living room" rather than merely place to sleep.

Halls

1. Practical minimum width—short hall, three feet; long hall, four feet.
2. Bedding closet—2′ wide by 22″ deep.
3. Entrance or guest closet—3′ wide by 24″ deep.

Bathroom

1. Reached from hall instead of a room.
2. Both tub and shower desirable.
3. Medicine cabinet and linen shelves.
4. Abundant light at mirror.
5. Outside window.

Basement

1. Basement optional—ground floor work-room may serve.
2. Space for work-room if not on first floor.
3. Entrance to outside.
4. Concrete floor and floor drain.
5. Waterproof walls—drain tile around outside below floor level.

Workroom—adjoining kitchen

1. Advantages over basement:
   (a) Easier access from outside and kitchen.
   (b) Eliminates stair climbing.
   (c) No drainage or moisture problem.
   (d) More desirable place to work.
2. May include:
   (a) Laundry equipment.
   (b) Canning equipment.
   (c) Heating unit for canning.
   (d) Cupboards for canned products and empty containers.
   (e) Freezing and other processing facilities.
   (f) Shower and lavatory.
   (g) Closet with ventilator and drain for work clothes and boots.
   (h) Water heater. unless connected to heating system.
   (i) Heating and cooling units for house (if no basement.
   (j) Cream separator and milk handling equipment for home milk supplies.

(k) Closet for storage of household cleaning equipment.

3. Construction features:
   (a) Storage cabinets with table top.
   (b) Shelves and wall cabinets.
   (c) Sink and drain.
   (d) Concrete floor with drains.

Personal Use Requirements of Farm Homes

The foregoing considerations are basic and should apply in most farm home planning. Individual preferences will govern the size, arrangement, and equipment of the various rooms. Iowa State College has worked out the following guide in planning the home from a functional standpoint.

USE THIS TO PLAN YOUR FARM HOME

What Work Is Done?	*Where Is It Done?* — *In Many Cases Here!*	*In My House Here*	*I'd Like It Here*
THE FAMILY LIFE			
Food Preparation			
Everyday:			
Cooking meals	Kitchen		
Dishwashing	Kitchen		
Serving meals	Dining room, kitchen		
Baking	Kitchen		
Butchering	Kitchen or outside		
Seasonal:			
Harvest (or other)	Kitchen or outside		
Food preservation	Kitchen or outside		
Social:			
Holiday	Kitchen		
Entertaining	Kitchen		
Food Storage			
Everyday:			
Perishables	Refrigerator or cave or basement		
Staples	Kitchen, pantry, or outside		
Preserved Foods:			
In jars	Basements, attics, or caves		
Dried			
Roots			
Frozen	Lockers		
Laundering			
Washing	Kitchen, porch or outside		
Drying	Everywhere in house or outside		
Ironing	Kitchen, dining room		
Storage of soiled clothing	Basket, closet floors, bedrooms or basement		
Clothing and its care			
Construction, care and repair	Bedroom, dining room, or outside		
Storage	Closet, nails		

USE THIS TO PLAN YOUR FARM HOME—Cont'd.

What Work Is Done?	*Where Is It Done?* — *In Many Cases Here!*	*In My House Here*	*I'd Like It Here*
Storage for cleaning tools			
Everyday	Cleaning closets—a few		
Thorough	Corner of kitchen		
	Back porch		
	Dining room		
	Vacuum cleaner—under bed		
Care of children			
Bathing	Kitchen, bathroom or outside		
Dressing	Bedroom or kitchen		
Toileting	Bathroom or privy		
Playing	Outside, dining room, recreation room, kitchen		
Training	Whole house		
Social relationship			
Family group	Living room, kitchen		
Individual—study	Dining room—bedroom		
Group play	Kitchen—living room, dining room		
Larger groups	Living area or recreation room		
Fuel Storage	Kitchen or outside		
THE FARM WORK IN HOUSE			
Care of workers			
Everyday:			
Wash, toilet,	Hall, porch, kitchen or outside		
Store work clothes	Kitchen or outside		
Storage of chore clothes	Kitchen or outside		
Business center for farmer	Hall, kitchen, dining room or outside		
Milk			
Separator	Service room, porch, pantry, or outside		
Storage of milk	Refrigerator, cooling tank or outside		
Poultry			
Egg storage	Porch or outside		
Little chicks (or other small animals)	Kitchen or outsitde		

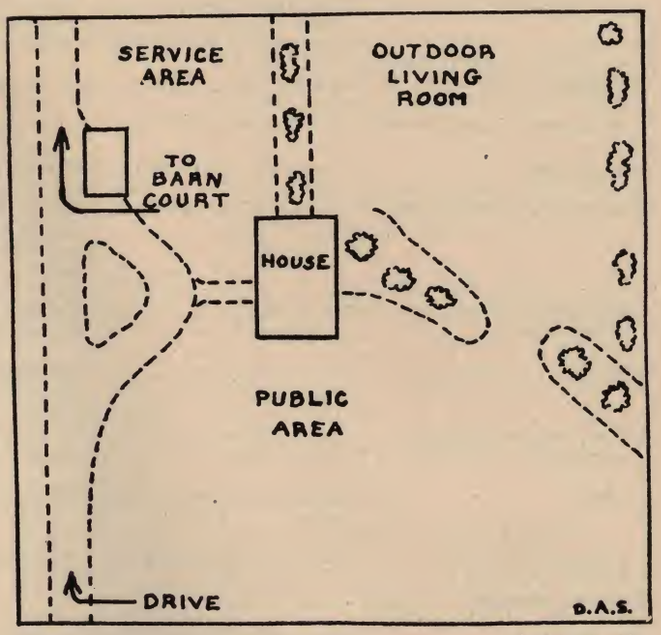
From: "Your Farm Home," Paulena Nickell, Iowa Farm Economist, April, 1945

Landscaping

Many a boy and girl have left the farm because of bare lots, the lack of trees and shrubbery, no lawns, and the absence of all features that make the landscape and the house an attractive home. Farm homes *can* be made attractive with rather simple landscaping. The following outline represents a summary of desirable landscape fea-

tures based on the opinions of landscape authorities of several agricultural colleges:

1. Divide yard around house into three areas partially separated by shrubs.
   (a) Public area—open yard between house and road or entrance.
   (b) Service area—between house and drive or barnyard for clothes lines, fuel house, etc.
   (c) Outdoor living room—back of house and mostly out of sight of public and service areas, for yard furniture, outdoor fireplace, etc.
2. Main driveway should lead from entrance to barnyard court with auxiliary "loop" to house and parking place.
3. Avoid flower beds, trees and shrubs, urns, etc., in open lawn areas.
4. Plant low shrubs around most of house, particularly around corners.
5. Avoid regular rows and straight lines in planting shrubs and also in walks.
6. Shade trees should be at least the distance of their mature height away from house.
7. Lawn should be graded for gradual slope away from house in all directions.
8. Plant varieties of trees, shrubs, and grass well adapted to locality. Consult county agricultural agent for information.
9. Select varieties retaining foliage most of season and avoid flowers with very short blooming periods.
10. Plan for simplicity and minimum time required for care of yard but be prepared to maintain lawn as diligently as other farm jobs are done. Beauty around a farm home adds to the desirability of farm life but a poorly kept landscape is a discouraging sight.



(D.A.S. Sketch)

The yard around the home should be divided into three areas

CHAPTER 9

LIVESTOCK, CROP AND MACHINERY STORAGE REQUIREMENTS

Beef Cattle—Basic Requirements

Beef Cattle are handled under many different conditions. Requirements on individual farms and ranches will therefore vary accordingly. The table below lists the most generally accepted requirements under practical management.

ITEMS	*Cows or 2-Year-Old Steers*	*Yearlings*	*Calves (400 to 500 lbs.)*	*Bulls*
Feed Lot				
Lot area—soil	300 to 1200 sq. ft. per hd.	300 to 1000 sq. ft. per hd.	150 to 500 sq. ft. per hd.	Optional
Lot area—surfaced	35 to 100 sq. ft. per hd.	35 to 80 sq. ft. per hd.	30 to 50 sq. ft. per hd.	Optional
Open Shed				
Floor area	20 to 40 sq. ft. per hd.	15 to 25 sq. ft. per hd.	12 to 20 sq. ft. per hd.	200 sq. ft. per hd. Enclosed building, 100 to 144 sq. ft.
Floor	Dirt preferred	Dirt preferred	Dirt preferred	Dirt preferred
Width (shed depth)	Minimum 20 ft. Optimum 24 to 32 ft.	Minimum 20 ft. Optimum 24 to 32 ft.	Minimum 20 ft. Optimum 24 to 32 ft.	20 ft.
Height, ceiling	8 to 10 ft.	8 to 10 ft.	8 to 10 ft.	8 ft.
	Clearance for power manure loader.			

Beef Cattle Basic—Requirements—(Continued)

ITEMS	*Cows or 2-Year-Old Steers*	*Yearlings*	*Calves (400 to 500 lbs.)*	*Bulls*
Supports, open shed posts	Spans between posts lengthwise of building 12 ft.—not less than 10 ft. nor more than 14 ft. Spans for width of buildings, no center pole needed if not over 24 ft. wide, gable roof, and on poles 4 to 5 ft. in ground. Use 20 ft. rafter ties and 1 x 6's crisscrossed between the 2 x 6 rafters and ties forming a simple nailed truss. Width spans of 26, 28, 30, and 32 ft. should have center post with rafters supported by side braces on posts to make unsupported portion of 2" x 6" rafters not over 14 ft.; or truss may be used to eliminate center post.			
Exposure	Open to south or east—except enclose 10% for calving.			
Foundation or splash board	Two feet above floor to allow for accumulation of manure.			
Feed storage	Varies greatly according to method of handling cattle.			
Hay, loose without silage	500 to 1000 cu. ft. per hd. (1 to 2 ton)	250 to 750 cu. ft. per hd. (½ to 1½ ton depending on field roughage and grain fed.)	125 to 500 cu. ft. per hd. (¼ to 1 ton depending on grain fed.)	500 to 1000 cu. ft. per hd.
Hay, baled or chopped without silage	250 to 500 cu. ft. per hd. (1 to 2 ton)	125 to 375 cu. ft. per hd. (½ to 1½ ton)	65 to 250 cu. ft. per hd. (¼ to 1 ton)	250 to 500 cu. ft. per hd.
Hay, loose with silage	250 to 500 cu. ft. per hd. (½ to 1 ton)	125 to 375 cu. ft. per hd. (¼ to ¾ ton)	65 to 250 cu. ft. per hd. (⅛ to ½ ton)	250 to 500 cu. ft. per hd.
Hay, baled or chopped with silage	125 to 250 cu. ft. per hd. (½ to 1 ton)	65 to 185 cu. ft. per hd. (¼ to ¾ ton)	30 to 125 cu. ft. per hd. (⅛ to ½ ton)	125 to 250 cu. ft. per hd.
Grain	Optional—None to 25 bu. per hd.	30 to 45 bu. per hd.	25 to 40 bu. per hd.	None
Protein Supplement	Optional—50 to 150 lbs.	100 to 300 lbs. per hd.	100 to 300 lbs. per hd.	None to 200 lbs. per hd.
Bedding Storage				
Straw, loose	300 to 1000 cu. ft. per hd. (⅓ to 1 ton)	300 to 1000 cu. ft. per hd. (⅓ to 1 ton)	250 to 750 cu. ft. per hd. (¼ to ¾ ton)	500 to 1000 cu. ft. per hd. (½ to 1 ton)
Straw, baled or chopped	70 to 200 cu. ft. per hd.	70 to 200 cu. ft. per hd.	50 to 175 cu. ft. per hd.	100 to 200 cu. ft. per hd.
Hay Manger				
Length—per head	24 inches (partitioned)	20 inches	18 inches	30 inches
Height—at throat	26 inches	24 inches	20 inches	26 inches
Feed Bunk				
Length—per head	24 inches	20 inches	18 inches	30 inches
Height—at throat	30 inches	30 inches	24 inches	30 inches
	(Hogs quickly learn to jump in bunks less than 30 inches high.)			
Water				
Lot feeding	1 sq. ft. open surface on pressure system per 25 head			
Pasture	350 to 600 gal. tank supplies 25 head.			

Dairy Cows—Basic Requirements

Dairy Cows are housed under two systems, stanchions and loafing barns. The loafing barn system is becoming more and more popular. The following table covers both:

ITEMS	*REQUIREMENTS*
Lot Area	
Lot—soil	300 to 1200 sq. ft. per cow, heifers 300 to 1000 sq. ft., bull lot size optional.
Lot—surfaced	35 to 100 sq. ft. per cow, heifers 35 to 80 sq. ft., bull lot size optional.
Loafing Barn	
Floor loafing area	40 to 100 sq. ft. per cow. Use smallest area when barn is supplemented with outside lot and when having a small breed. Heifers, 20 to 40 sq. ft.; bull, 100 to 144 sq. ft. or approximately 200 sq. ft. when using open shed.

Dairy Cows—Basic Requirements—(Continued)

ITEMS	*REQUIREMENTS*
Width—loafing area	Minimum for cows 16 ft., heifers 12 ft., bull 10 ft.
Width open shed	24 ft. to 32 ft.
Height—ceiling	8 ft. to 10 ft.—clearance for power manure loader.
Supports—open shed posts	Spans between posts lengthwise of building 12 ft.—not less than 10 ft. nor more than 14 ft. Spans for width of building, no center pole needed if not over 24 ft. wide, gable roof, and on poles 4 to 5 ft. in ground. Use 20 ft. rafter ties and 1 x 6's crisscrossed between the 2 x 6 rafters and ties forming a simple nailed truss. Width spans of 26, 28, 30, and 32 ft. should have center post with rafters supported by side braces on posts to make unsupported portion of 2 x 6 rafters not over 14 ft.; or truss may be used to eliminate center post.

Dairy Cows—Basic Requirements (Continued)

ITEMS	*REQUIREMENTS*
Foundation or splash board	2 ft. above floor to allow for accumulation of manure.
Floor	Well drained dry soil is most satisfactory.
Exposure	Open to south or east—except enclosed maternity stalls and calf pens.
Hay Manger— Open type—length	3 ft. to 5 ft. per cow, 3 ft. per heifer, 3 ft. per bull.
Partitioned—length	32″ to 36″ per cow, 24″ to 32″ per heifer.
Water	Winter—under pressure, 1 sq. ft. open surface per 25 cows; water bowls in maternity, calf, and bull pens. Summer—tank 15 to 25 gal. per head.
Bedding— Straw—loose	15 to 25 lbs. per cow per day, allow 1500 to 2000 cu. ft. (2 ton) per cow, 700 to 1000 cu. ft. (1 ton) per heifer, and 1500 to 2000 cu. ft. per bull.
Straw-baled or chopped	400 cu. ft. (2 ton) per cow, 200 cu. ft. (1 ton) per heifer, and 400 cu. ft. per bull.
Stanchion Barn	
Width of barn	34 ft. to 36 ft.
Floor area	60 to 80 sq. ft. per cow including stalls, mangers, feedway, and litter alley; heifers, varies according to how handled; bulls, 100 to 144 sq. ft.
Stall size:	
Holstein—length	4′10″ to 5′8″
—width	3′6″ to 5′0″
Ayrshire —length	4′6″ to 5′6″
—width	3′6″ to 4′6″
Guernsey —length	4′6″ to 5′4″
—width	3′4″ to 4′0″
Jersey —length	4′4″ to 5′0″
—width	3′4″ to 4′0″
Height, ceiling	7′6″ to 8′ in cold areas, 8′ to 9′ in moderate areas.
Foundation or splash board	Extend at least 12″ above floor
Floor	Solid and impervious
Gutters—width	16″ to 18″
—depth	8″ at stalls, 6″ at litter alley
Litter alley	8′ wide—permit driving spreader through.
Feedway	3′6″ to 4′6″ wide.

Dairy Cows—Basic Requirements (Continued)

ITEMS	*REQUIREMENTS*
Mangers	24″ to 30″ wide.
Water	Under pressure, water bowl for every 2 cows, bowls in maternity, calf, and bull pens.
Manure pit	Not recommended unless no way possible to haul manure direct to field. Capacity 1½ cu. ft. per cow per day. Separate tanks for liquid manure desirable but not always practical.
Bedding— Straw—loose	8 to 12 lbs. per cow per day. Allow 500 to 750 cu. ft. (¾ ton) per cow, 250 to 400 cu. ft. (⅜ ton) per heifer, and 500 to 750 cu. ft. per bull.
Straw—baled or chopped	150 cu. ft. (¾ ton) per cow, 75 cu. ft. (⅜ ton) per heifer, and 150 cu. ft. (¾ ton) per bull.
General	
Maternity pens	12 ft. by 12 ft.
Bull pens	10 ft. by 10 ft. to 12 ft. by 12 ft.
Calf pens	24 sq. ft. per calf.
Doors	Single, 3′6″ to 4 ft. wide; double, 8 ft.
Light	Windows, 3 to 3½ sq. ft. per cow; electric, one 60-watt bulb per 4 cows.
Feed Storage— Hay, loose—without silage	1000 to 1500 cu. ft. (2 to 3 ton) per cow or bull, 500 to 750 cu. ft. (1 to 1½ ton) per heifer.
Hay, baled or chopped—without silage	400 to 600 cu. ft. (2 to 3 ton) per cow or bull, 200 to 300 cu. ft. (1 to 1½ ton) per heifer.
Hay, loose—with silage	500 to 1000 cu. ft. (1 to 2 ton) per cow or bull, 250 to 500 cu. ft. (½ to 1 ton) per heifer.
Hay, baled or chopped—with silage	200 to 400 cu. ft. (1 to 2 ton) per cow or bull, 100 to 200 cu. ft. (½ to 1 ton) per heifer.
Grain—3 to 4 weeks' supply	Allow 8 to 10 cu. ft. per cow, bull, and heifer.
Supplement—3 to 5 months' supply	Allow 6 to 8 cu. ft. per cow, bull, and heifer.
Milking Room	For ideas on different types see Chapter 4.
Milk House	For requirements see Chapter 4.

Hogs—Basic Requirements

Hogs require close conformity to proper conditions if the enterprise is to be successful. The requirements listed have been based on profitable hog units. Variations should be allowed only for unusual conditions.

ITEMS	*Sows*	*Pigs Under 100 lbs.*	*Fattening Hogs 100 to 200 lbs.*	*Boars*
Pasture and Lot Area				
Pasture	1 to 3 sows per acre, average 2 (including their pigs for the season)	15 to 25 head per acre	10 to 20 head per acre	1/5 to 1/10 acre per boar
Dry Lot—Surfaced	20 to 30 sq. ft. per sow	8 to 12 sq. ft. per head	12 to 20 sq. ft. per head	25 to 35 sq. ft. per boar
Buildings				
Floor Area	Before farrowing—20 to 35 sq. ft. During and after farrowing—48 to 80, average 64 sq. ft.	3 to 6 sq. ft.	6 to 10 sq. ft.	20 to 65 sq. ft.

Hogs—Basic Requirements—(Continued)

ITEMS	*Sows*	*Pigs Under 100 lbs.*	*Fattening Hogs 100 to 200 lbs.*	*Boars*
Guard Rails	8 to 12 inches from wall. 8 to 10-inch clearance above floor	———	———	———
Pen Partition—Height	36 inches	32 inches	36 inches	42 inches
Windows	1 sq. ft. per 30 to 40 sq. ft. floor space	1 sq. ft. per 30 to 40 sq. ft. floor space	1 sq. ft. per 30 to 40 sq. ft. floor space	1 sq. ft. per 30 to 40 sq. ft. floor space
Doors	24 inches wide 36 inches high	24 inches wide 36 inches high	24 inches wide 36 inches high	24 inches wide 36 inches high
Shade	20 to 30 sq. ft. 4 ft. high	5 to 8 sq. ft. 4 ft. high	8 to 12 sq. ft. 4 ft. high	20 to 30 sq. ft. 4 ft. high
Sanitation	Portable shelter, feeding and watering equipment.			
Feeding and Watering Equipment				
Self Feeder—Ear corn, grain or carbohydrate feed	1 linear foot feeder space per 2 to 3 sows	1 linear foot feeder space per 6 to 10 head	1 linear foot feeder space per 4 to 6 head	1 linear foot feeder space per boar
Self Feeder—Supplement (high protein)	1 linear foot per 3 sows	1 linear foot per 10 head	1 linear foot per 10 head	1 linear foot per 2 boars
Feeding floor, with self feeders (feeder space included)	3 to 4 sq. ft. per sow	1 to 1½ sq. ft. per head	1½ to 2½ sq. ft. per head	4 to 6 sq. ft. per boar
Feeding floor, hand feeding	15 to 20 sq. ft. per sow	4 to 6 sq. ft. per head	8 to 10 sq. ft. per head	15 to 25 sq. ft. per boar
Feed trough	18 inches to 20 inches	10 inches	14 inches	24 inches
Water per day	5 to 8 gal.	½ to 1½ gal.	1½ to 3 gal.	2 to 4 gal.
Water trough space	1 ft. per 10 to 15 sows	1 ft. per 40 to 50 head	1 ft. per 25 to 30 head	1 ft. per 3 boars
Feed Storage—One Year Supply				
Grain	9 cu. ft. (7 bu.) per 100 lbs. gained weight including feed space for sows, pigs, and boars, or 20 cu. ft. (16 bu.) grain space per 225 lb. hog raised, 40 cu. ft. if grain is ear corn.			
Protein Supplement	1 cu. ft. (50 lbs.) per 100 lbs. gained, including feed space for sows, pigs, or boars.			
Alfalfa Meal	5 cu. ft.	1 cu. ft.	2 cu. ft.	3 cu. ft.
Bedding Storage				
Straw, loose	250 to 400 cu. ft. (500 to 800 lbs.)	25 cu. ft. (50 lbs.)	50 cu. ft. (100 lbs.)	100 cu. ft. (200 lbs.)
Straw, baled or chopped	50 to 80 cu. ft.	5 cu. ft.	10 cu. ft.	20 cu. ft.

Horses (Draft)—Basic Requirements

ITEMS	*MARE*	*COLT, YEARLING, TWO-YEAR-OLD*
Stall Size		
Floor area	60 to 80 sq. ft.	.....
Width	5′	.....
Length—including manger	14′ to 16′	.....
Box Stall	10′x 10′ to 12′x 14′	8′x 10′ or 10′x 10′
Height	8′	8′
Hay Manger		
Width	2′ to 3′	2′
Height at throat	38″ to 42″	32″ to 36″
Grain Box		
Width	12″	10″ to 12″
Length	24″	12″ to 24″
Height—sides	8″ to 10″	6″ to 8″
Height—above floor	38″ to 42″	32″ to 36″
Feed Storage		
Hay—loose	1000 cu. ft. (2 ton)	750 cu. ft. (1½ ton)
Grain	50 to 100 cu. ft. (40 to 80 bu.)	25 to 50 cu. ft. (20 to 40 bu.)
Bedding		
Straw—loose	500 cu. ft. (½ ton)	250 cu. ft. (¼ ton)
Straw—baled or chopped	100 cu. ft. (½ ton)	50 cu. ft. (¼ ton)

Poultry—Basic Requirements

Poultry must be closely controlled. Requirements vary with minor climatic conditions. The table lists the customary requirements for most conditions but poultry raisers are advised to consult local authorities regarding their particular conditions. Most State Colleges have devoted extensive study to poultry production and County Agricultural Agents can supply results of their findings.

ITEMS	*HENS*	*CHICKS*
Lot and Outside Pen		
Lot area	175 to 200 sq. ft. per hen	Open range—100 to 125 sq. ft. per chick
Outside pen—supplement floor area	4 to 8 sq. ft. desirable where building floor area is less than 3 sq. ft. per bird.	Where open range not available—1 to 3 sq. ft. to supplement brooder floor area as chicks become larger.
Buildings		
Floor area	2 to 3½ sq. ft. per hen.	Baby chicks—⅓ to ½ sq. ft. Growing chicks—½ to 1½ sq. ft. Broilers—½ to ¾ sq. ft.
Roost space	7″ to 10″ per hen 13″ to 15″ apart	5″ to 7″ 8″ to 10″ apart
Roost height	12″ to 15″ above litter	10″ to 15″ above floor
Nests	1 per 5 to 7 hens 12″ wide, 14″ long, 14″ high	
Windows	1 sq. ft. window per 25 to 50 sq. ft. floor	Approx. 1 sq. ft. window per 30 sq. ft. floor
Electric lights	50 Watt bulb per 200 sq. ft. floor. Give 12 to 14 hr. day.	
Doors for chickens	One 15″x 16″ per 100 hens.	One 10″ x 12″ per 100 chicks
Food Storage		
Mash	4 to 6 weeks supply—10 to 15 cu. ft. (500 to 750 lbs.) per 100 birds	2 to 3 weeks supply—2 to 3 cu. ft. (100 to 150 lbs.) Per 100 birds
Grain (Scratch)	10 to 20 cu. ft. (500 to 1000 lbs.) per 100 chicks	2 to 3 weeks supply—2 to 3 cu. ft. (100 to 150 lbs.) per 100 birds
Feeding and Watering Equipment		
Feed Troughs	3″ to 5″ per hen	Baby chicks—1″ per bird Growing chicks—3″ per bird
Self-feeder	1″ feeder space per hen	¾″ to 1″ feeder space per bird
Waterers	6 gal. per 100 hens per day Farm flock—two 3 gal. buckets on stands per 100 hens Commercial—one automatic waterer per 600 hens	Baby chicks—1 qt. fountain per 50 chicks Growing chicks—1 to 2 gal. fountain per 50 birds Broilers—1 automatic waterer per 600 birds

Sheep—Basic Requirements

Sheep can be raised successfully with minimum conformity to requirements, but feeding for market should be done under favorable conditions. The requirements listed are more adaptable to the farm flock from which the lambs are fed out and to normal feeder lamb operations rather than to large commercial units.

ITEMS	*EWES (WITH LAMBS) OR RAMS*	*FEEDER LAMBS*
Feed Lot		
Lot area—soil	25 to 50 sq. ft.	8 to 15 sq. ft.
Lot area—surfaced	15 to 20 sq. ft.	6 to 8 sq. ft.
Building		
Floor area	15 to 22 sq. ft.	5 to 8 sq. ft.
Pens	Provide 1 pen to 5 ewes. Use two 4 ft. gates hinged together set as pen along wall.	
Partition fence	38″ high—12″ board at ground, 6″ space, 6″ board, 6″ space, and 6″ board on top. Posts 12′ apart.	
Width (shed depth)	20 to 24 feet	20 to 24 feet
Height	8 to 10 ft.—clearance for power manure loader.	8 to 10 ft.—clearance for power manure loader.
Supports	Spans between posts 12 ft.—not less than 10 ft. nor over 14 ft.	
Exposure	Facing south or east. Open except 10% closed for lambing.	Open to south or east.
Feed Storage		
Hay, without silage loose	150 cu. ft. (600 lbs.)	25 cu. ft. (100 lbs.)
Baled or chopped	60 cu. ft. (600 lbs.)	10 cu. ft. (100 lbs.)
Hay, with silage loose	75 cu. ft. (300 lbs.)	13 cu. ft. (50 lbs.)
Baled or chopped	30 cu. ft. (300 lbs.)	5 cu. ft. (50 lbs.)
Grain	1 to 2 cu. ft. (50 to 100 lbs.)	2 to 3 cu. ft. (100 to 150 lbs.)
Bedding Storage		
Straw, loose	50 to 80 cu. ft. (100 to 160 lbs.)	17 to 32 cu. ft. (35 to 65 lbs.
Baled or chopped	10 to 16 cu. ft. (100 to 160 lbs.)	3½ to 6½ cu. ft. (35 to 65 lbs.)
Hay Feeding Rack		
Length—per head	18″ to 24″	12″ to 14″
Width—feed both sides	20″ to 24″	19″ to 21″
Width—feed one side	14″ to 16″ 1″ by 6″ at 45° angle across lower inside corner.	12″ to 14″
Height—at throat	12″ to 15″	10″ to 12″

Important savings can be made by use of proper lumber grades. Generally too much lumber of too high quality is used.

Your retail lumber dealer can answer many questions about farm buildings.

Sheep—Basic Requirements—(Continued)

ITEMS	EWES (WITH LAMBS) OR RAMS	FEEDER LAMBS
Hay Feeding Fence	12″ board at ground, 8″ open space, 8″ board, space per feeder lamb, 9″ to 10″.	8″ open space. and 6″ board on top. Linear
Grain Trough		
Length—per head	14″ to 18″	10″ to 12″
Width—feed both sides	20″ to 24″	19″ to 21″
Width—feed one side	14″ to 16″	10″ to 12″
Height—at throat	12″ to 15″	10″ to 12″
Self Feeder		
Length—per head	Not used	3″ to 4″
Width of feed area		8″ to 10″
Height—at throat		10″ to 12″
Depth—where lambs eat		5″ to 6″
Creep		
For lambs with ewes	Openings 8″ to 12″ wide	
Water	1 gal. per day	½ gal. per day

Grain Storage—Basic Requirements

Grain storage space will vary with the proportion of crop marketed direct from the machine as harvested. It requires good management to make a profit on storing grain. Good storage facilities that prohibit wastage will normally net a return in a slightly higher price for the grain and a saving in hauling costs by marketing at a time when the operator can haul it himself. There is also increased convenience at harvest, especially if market facilities are over-crowded. Elevating equipment should be available where quantities of grain must be stored. See Chapter 4 for ideas on centralized grain storage.

For ordinary farm conditions, grain storage structures in units 8 feet by 8 feet by 10 feet to the high plate are the most desirable structurally and from a use standpoint. *The following are general specifications for a single unit.* Note that the building is high enough above the ground level to permit dogs and cats to roam under it as a protection against rodents.

ITEMS	REQUIREMENTS
Foundation	Three concrete piers each 8 ft. long. (Usually more satisfactory than solid concrete floor.) Location—2 at extreme sides and one through center. Width—8″ at ground, 6″ at top Depth—18″ above ground, normally 12″ to 36″ below ground (below frost line).
Sills	Three 2″ x 6″ x 8′ attached flat to foundation walls with bolts in concrete.
Joists	Seven 2″ x 10″ x 8′ across foundation walls, 16″ on centers.
Studding	2″ x 6″ x 10′ on 16″ centers bolted to joists.
Plates	Double 2″ x 6″ on top of studs.
Protection—rats, mice	¼″ hardware cloth between joists and floor and 3 to 4 ft. high between studding and siding. Line tight-fitting doors.
Flooring	1″ x 4″ tongue and groove (use good grade for scooping).
Lining	1″ x 4″ or 6″ tongue and groove inside the studs.

ITEMS	REQUIREMENTS
Siding	1″ x 6″ drop siding (good tight single wall is satisfactory).
Bracing	2″ x 10″ flat against studs extending around interior 4 ft. from floor. Attach with bolts or clamps.
Roof	Single row bins—one slope with front side 2 ft. higher than back. Double crib and granary—regular gable roof.
Doors	Elevator filling door in front or in roof—minimum inside clearance 18″ square. Scoop-in door 8 ft. high, 24″ x 30″. Entry door 30″ x 6′6″ with louver type scoop hopper.
Light	One 4-light (8″ x 10″) window near top for each bin.

Grain Bin-Drying—Forced Air Ventilation

ITEMS	REQUIREMENTS
Kind of Grain	Shelled corn, small grain, and soybeans—allows earlier harvesting with higher moisture than safe for regular storage.
Bin Capacity	Fill 8′ x 8′ x 10′ bins approximately one-half full or use bins holding 200 to 300 bu. figured at 1¼ cu. ft. per bu.
Floor	Install perforated floor 4″ above regular floor, using 3/16″ hardware cloth supported by 2 x 4's and slats; or, perforated plywood; or, 1″ x 2″ or 1″ x 3″ slats with ⅛″ cracks between.
Blower	Blow air between the two floors. Requires 1 to 3 cu. ft. of air per minute per bu. Use ¼ to ½ H.P. motor with low pressure blower operating at 375 to 550 R.P.M. Power required is usually ½ KWH per bu.
Operating Blower	Operate blower continuously until moisture is reduced to safe storage percentage. Warm mid-day air will dry grain most rapidly. Cool night air will keep grain from heating and prevent spoilage.

"Wood has long proved its wide suitability for farm buildings, and the farmer has a long background of experience with wood construction."— Frank J. Hallauer, Principal Engineer, Forest Service, U.S.D.A.

MACHINERY STORAGE

Space Requirements

Machinery Storage is more important now than ever. Power farming with all of its mechanized equipment demands easily accessible shelter if machinery is to be kept in top condition, instantly ready for field work. The requirements listed should aid those who are building or remodeling storage space. Actual measurements of present equipment, with allowance for some variations in new models, are to be preferred to the dimensions listed.

Machinery—Space Required for Storage

Item	Requirements (in feet)		
	Width	Height	Length
Automotive			
Car	7	6½	18
Tractor—One Bottom	5	5	9
Two Bottom	7½	5	12
Three Bottom	7½	5	12
Truck—Pickup	7½	7	20
Stock Rack	8	10	26
Grain Bed	8	7	26
Semi-trailer	8	9	26
Binders			
Grain—8 ft.—reel off	10	5	16
Grain—10 ft. tractor—reel on	12	8	19
Corn—One Row	7	7	12
Corn—Two Row	9	7	16
Baler	13	5–6	21
Bob-sleds	6	—	6
Combines			
Combines—5 to 6 ft.	9 to 12	8½	16 to 20
Combine—12 ft.	13	12	22
Combine—16 ft.	20	14	25
Cultivators			
Corn, one-row	5	4	6
Corn, two-row (tractor)	10	—	6
Corn, four-row (tractor)	15	—	8
Rotary hoe	10	3	6
Diggers, Potato	5	—	8
Drill, Grain			
8 ft., 14-7	11	5	6
10 ft., 16-7	13	5	6
14 ft., 24-7	18	5	7
Hammer Mill	4	3	9½
Harrow			
Spike-Tooth	4	—	6
Spring-Tooth	3	—	6
Disk, Horse	8	—	6
Disk, Tractor	10	—	8½
Loader			
Hay	8	10	12 to 15
Manure	3 to 4	6 to 9	4 to 10
Mower			
Horse—Bar Up	5	6	8
Tractor—Trailer Type 7 ft. —Bar Up	5	8	4 to 6
Pickers, Corn			
One-Row, Pull-type	8	6 to 7	12
Two-Row, Pull-type	16	6 to 7	17
Planters			
Corn, Two-Row	10	—	6
Corn, Four-Row	15	—	6
Potato	6	—	8
Plows			
Walking	2	—	8
Sulky	5	4	7
Two-Bottom, Horse	5	4	8
Two-Bottom, Tractor	5 to 6	4	9½ to 11
Three-Bottom, Tractor	6	4	11 to 13
One-Way Disk	9	—	10 to 14
Racks, Hay	8	8	16
Rakes			
Dump, 10 and 12 ft.	12 to 15	4½	6
Side-Delivery	8 to 11	4½	12
Sweep—Tractor	9 to 13	3 to 4	9 to 10
Tedder 8-Fork	9	5	6
Seeders			
Box Type, 11 Ft.	13	4	6
Silo Fillers	5	6	10
Sprayers, Potato	8	—	6
Spreaders			
Manure, Horse	6	4½	15
Manure, Tractor	6	4½	18
Tiller	12 to 16	—	12
Thresher, Grain Separator	8 to 10	10	23 to 29
Wagon			
Box and Gear—High Wheel	6	5½	14
Gear	6	3	9
Box and Gear—Rubber Tire	6	4½	14

CHAPTER 10 LUMBER USE GUIDES

Wood, as a material of construction about a farm, is the most versatile and economical material available. It comes in a wide variety of standard sizes, lengths, grades and species and is as easily purchased from neighborhood sources as a box of crackers from the grocer. It is easily worked, is durable, has a pleasing appearance and "feel" and that which is built of wood is readily altered to suit changed conditions.

To use wood to the best advantage, some knowledge of the diversity in which it is obtainable and how to select for specific uses is necessary.

Lumber is Standardized

Lumber, for many years, has been standardized in sizes and grades commercially available to the average buyer. This standardization has evolved for the mutual benefit

of the manufacturer, dealer and consumer. The standard cross sectional dimensions are grouped into categories which have been mostly determined by customary use. Some of these categories are: boards, plank, dimension and timber. For further information on these dimensions, see Table No. 1.

Lumber is sold rough or surfaced and surfacing may be on any one side or edge or combination, but that which is usually available is surfaced on all faces. Abbreviations used to designate surfacings are:

S1S —Surfaced one side
S1E —Surfaced one edge
S1S1E—Surfaced one side and one edge
S1S2E—Surfaced one side and two edges
S2S —Surfaced two sides
S2E —Surfaced two edges
S2S1E—Surfaced two sides and one edge
S4S —Surfaced four sides

All dealing in lumber is based on the rough size before surfacing. This rough size is called the *nominal size* and the unit of measure used in transactions is the foot-board-measure computed from nominal dimensions. A foot-board-measure, designated by the abbreviation "f.b.m.," is equal to a piece one inch thick, twelve inches wide and one foot long.

TABLE No. 1

LUMBER AND TIMBER SIZES

SIDING, FLOORING, CEILING, PARTITION FINISH — CLEARS — STEPPING

PRODUCT	THICKNESSES		WIDTHS		
	Nominal Rough Green Thickness Inches	*Standard S1S or S2S Thickness Inches*	*Nominal Rough Green Widths Inches*	*Standard S1E or S2E Face Widths Inches*	*Over all Widths Inches*
Drop Siding (T&G)	1	9/16 3/4	4 6 8	3-1/4 5-3/16 6-11/16	3-1/2 5-7/16 7-3/16
Rustic (Shiplapped)	1	9/16 3/4	4 6 8	3-1/8 5-1/16 6-11/16	3-1/2 5-7/16 7-3/16
Flooring	1 1¼ 1½ 2	25/32 1-1/16 1-5/16 1-5/8	3 4 6	2-3/8 3-1/4 5-3/16	2-5/8 3-1/2 5-7/16
Ceiling 3" & 4" Widths		5/16 7/16 9/16 11/16	3 4	2-3/8 3-1/4	2-5/8* 3-1/2*
Ceiling 6" Widths		23/32	6	5-3/16	5-7/16
Stepping, Finish & Clears	1 1¼ 1½ 2	11/16 25/32 1-1/16 1-5/16 1-5/8	2 3 4 5 6 8 10 12 over 12	1-5/8 2-5/8 3-1/2 4-1/2 5-1/2 7-1/4 9-1/4 11-1/4 1" off	

*Apply to 11/16"; other thicknesses 1/16" less in overall width due to shorter tongue.

CONSTRUCTION GRADES

PRODUCT	THICKNESSES		WIDTHS	
	Nominal Rough Green Inches	*Standard S1S or S2S Inches*	*Nominal Rough Green Inches*	*Standard Dressed Face Widths Inches*
Boards Dimension Plank & Small Timbers	1 1¼ 1½ 2 2½ 3 3½ 4	25/32 1-1/16 1-5/16 1-5/8 2-1/8 2-5/8 3-1/8 3-5/8	2 3 4 6 8 10 12 over 12	1-5/8 2-5/8 3-5/8 5-5/8 7-1/2 9-1/2 11-1/2 1/2" off
Stringers, Posts & Timbers	5 x 5 and Larger	1/2" off	5 x 5 and Larger	1/2" off
Shiplap (Lap 3/8")	1	25/32	4 6 8 10 12	3-1/8 5-1/8 7-1/8 9-1/8 11-1/8
Center Matched (Tongue ¼")	1	25/32	4 6 8	To Patterns
Center Matched (Tongue ⅜")	2 2½ 3 3½ 4	1-5/8 2-1/8 2-5/8 3-1/8 3-5/8	4 6 8 10 12	To Patterns

Selection of Lumber

Selection of lumber for a specific use, other than by size, should be made by species and by grade. For decorative purposes, the texture and color of a species might be a determining factor. Ordinarily, selection by species is made for durability and for strength. Durability is important when the wood is exposed to conditions conducive to decay, such as contact with the ground, condensation and moisture. The sapwood, a layer of wood at the outer circumference of a tree and distinctly lighter in color than the heartwood, is not rated as durable in any species. Some West Coast species are rated for durability, under conditions favoring decay, as follows:

Heartwood, highly durable—Western Red Cedar
Heartwood, durable—Douglas Fir
Heartwood, slightly durable—West Coast Hemlock and Sitka Spruce

The durability of any species, including the sapwood of the species, is equalized and made superior to the most durable wood by pressure impregnating with a good preservative. Such preservatively treated wood is reasonably available.

Strength of Species

The strength of species varies, but strength can be a confusing factor. Using Douglas Fir, a wood of highest strength, as a base some other West Coast species would approximately rate in strength as follows:

Douglas Fir.....100%
West Coast Hemlock..... 80%
Sitka Spruce..... 70%
Western Red Cedar..... 55%

However, for ordinary construction, the same grade will be found available in each species with the intent that they

can be interchanged in use. Though strength is a factor, the average requirements of the use are the major consideration and sufficient strength is provided to support the load. If strength alone is the prime consideration, a strength comparison can be made between two species by using a better grade of the weaker species or a larger piece.

Combinations of desirable properties will affect selections. For example: skids under a portable building would need toughness and durability. Douglas fir would provide the best combination. The sills of a modest chicken house, when resting on the ground, would require durability and Western Red Cedar provides the most. The stringers under a water tank, being liable to much dampness and difficult to replace, should have very high durability and strength. For this purpose preservative pressure treated Douglas fir should be used.

Appropriate Grades for Particular Uses

The variety of grades available in lumber is a distinct economic advantage. Grades, commensurate with the quality of work being undertaken, can make an advantageous saving on the job, for the quality of the grade is a measure of the price. The spread of grades, appropriate for various types of construction and structural use, is given in the following tables.

TABLE No. 2
LIGHT FRAME CONSTRUCTION

USE	DOUGLAS FIR		WEST COAST HEMLOCK		SITKA SPRUCE		WESTERN RED CEDAR		
	Grade	*Paragraph†*	*Grade*	*Paragraph†*	*Grade*	*Paragraph†*	*Grade*	*Paragraph†*	*Item*
Sleepers and Mud Sills, and Sills on Masonry	No. 1 No. 2 No. 3	208 209 206	No. 1 No. 2 No. 3	608 609 606	No. 1 No. 2 No. 3	833 834 835	No. 1 No. 2 No. 3	964 965 965a	Dimension
Posts up to 4″x 4″*	No. 1 No. 2 No. 3	208 209 206	No. 1 No. 2 No. 3	608 609 606	No. 1 No. 2 No. 3	833 834 835	No. 1 No. 2 No. 3	964 965 965a	Dimension
Posts over 5″x 5″*	No. 1 No. 2 No. 3	218 219 220	No. 1 No. 2 No. 3	618 619 620	No. 1 No. 2 No. 3	839 840 841	No. 1 No. 2	958 959	Posts and Timbers
Studs, Plates, Caps, Headers, Trimmers‡	No. 2 No. 3*	209 206	No. 2 No. 3*	609 606	No. 2 No. 3*	834 835	No. 2 No. 3*	965 965a	Dimension
Joists, Rafters, Stair Stringers (4″ and thinner)+	No. 1 No. 2‡	208 209	No. 1 No. 2‡	608 609	No. 1	833	No. 1	964	Dimension
Beams, Girders, Stringers (5″ and thicker)♣	1900f 1700f 1450f	212 213 214	1450f	614	Sel. Merch. Strs. No. 1 Stringers	838 839			Beams, Stringers and Timbers
Ribbon Boards, Ledger Boards, Collar Boards, Sub-floors	No. 1 No. 2	187 188	No. 1 No. 2	587 588	No. 1 No. 2	826 827	No. 1 No. 2	952 953	Boards or Shiplap
Wall Sheathing, Roof Sheathing, Furring, Grounds	No. 2 No. 3	188 189	No. 2 No. 3	588 589	No. 2 No. 3	827 828	No. 2 No. 3	953 954	Boards or Shiplap
Lath	No. 1 No. 2	177 178	No. 1 No. 2	577 578	No. 1 No. 2	821 822	No. 1 No. 2	947 948	Lath

†All paragraph numbers in this column refer to West Coast Bureau of Lumber Grades and Inspection—Standard Grading and Dressing Rules No. 14.
*No. 3 Grades for temporary construction or to be cut up to short lengths eliminating major defects.
‡No. 3 for temporary construction, non-bearing partitions or where carrying a roof or ceiling only.
+No. 2 on temporary construction or on permanent construction with spans two-thirds of those used for No. 1 of same size.
♣Stress values for beams, etc. in bending are indicated by "f" (fiber stress in bending). Where stress requirements are critical, an architect or engineer should be consulted for determination of size and grade.

SHINGLES

Grading and packing rules of Red Cedar Shingle Bureau

ROOFS	SIDE WALLS
No. 1, 16″- 5/2	No. 1, No. 2 or No. 3, 16″- 5/2
No. 1, 18″- 5/2¼	No. 1, No. 2 or No. 3, 18″- 5/2¼
No. 1, 24″- 4/2	No. 1, No. 2 or No. 3, 24″- 4/2

GLUED LAMINATED CONSTRUCTION

Barn Rafters, Beams, Arches.....	Such members should only be purchased as members fabricated by qualified manufacturers.

West Coast Woods are noted for their large heartwood content. This is important because the heartwood of any species is far more durable than the sapwood.

TABLE No. 3
TOWERS

USE	DOUGLAS FIR		WEST COAST HEMLOCK		SITKA SPRUCE		WESTERN RED CEDAR		ITEM
	Grade	*Paragraph†*	*Grade*	*Paragraph†*	*Grade*	*Paragraph†*	*Grade*	*Paragraph†*	
Sills, Caps and Joists (under 4″ least dimension)	1900f 1700f 1450f 1100f	202 203 204 205					Sel. Merch. No. 1	963 964	Framing and Plank
Sills, Caps and Joists (over 5″ least dimension)	1900f 1700f 1450f	212 213 214							Beams and Stringers
							No. 1 No. 2	958 950	Timbers
Legs (4″x 4″ or less) and Struts (heavy)	1900f 1700f 1450f 1100f No. 1 No. 2	202 203 204 205 208 209	Small Posts				Sel. Merch. No. 1 No. 2	963 964 965	Small Timbers
Legs (5″x 5″ and over)	1450c 1400c No. 1 No. 2	216 217 218 219					No. 1 No. 2	958 959	Posts and Timbers
Bracing (light), Ladders and Handrails	Sel. Merch. No. 1	186 187					Sel. Merch. No. 1	951 952	Boards
Struts (light)	No. 1 No. 2	208 209	Small Posts				Sel. Merch. No. 1	963 964	Dimension and Small Timbers
Bracing (heavy)	1900f 1700f 1450f 1100f	202 203 204 205					Sel. Merch. No. 1	963 964	Framing and Plank

†All paragraph numbers in this column refer to West Coast Bureau of Lumber Grades and Inspection—Standard Grading and Dressing Rules No. 14.

TABLE No. 4
INTERIOR FINISH

USE	DOUGLAS FIR		WEST COAST HEMLOCK		SITKA SPRUCE		WESTERN RED CEDAR		ITEM
	Grade	*Paragraph†*	*Grade*	*Paragraph†*	*Grade*	*Paragraph†*	*Grade*	*Paragraph†*	
Natural or Stained Finish and Trim	B and Better VGorFG	113	B and Better VGorFG	513	B and Better VGorFG	805	B and Better VGorFG	740	Finish
Painted or Enameled Finish and Trim	B and Better C	113 114	B and Better C	513 514	B and Better C	805 806	B and Better C	740 741	Finish
Knotty Paneling and Finish	*No. 1	187	*No. 1	587	*No. 1	826	Sound Knotted Paneling	749	Boards or Knotty Paneling
Ceiling	B and Better C	154 155	B and Better C	554 555	B and Better	811	B and Better C	744 745	Ceiling
Partition	B and Better C	154 155	B and Better C	554 555	B and Better	811	B and Better C	744 745	Ceiling, V or Beaded 2 Sides
Shelving	B and Better C No. 1	113 114 187	B and Better C No. 1	513 514 587	B and Better C No. 1	805 806 826	B and Better C No. 1	740 741 752	Finish or Boards
Flooring, Uncovered	B VG C VG	134 135	B VG C VG	534 535					Vertical Grain Flooring

(Continued on next page.)

"Any tendency to buy the best the market offers for all uses is wasteful of both lumber and money, for in many uses the lower and cheaper grades will render as long and satisfactory service."—U.S.D.A. Farmers' Bulletin No. 1756.

TABLE NO. 4 (Continued)

USE	DOUGLAS FIR		WEST COAST HEMLOCK		SITKA SPRUCE		WESTERN RED CEDAR		ITEM
	Grade	*Paragraph*†	*Grade*	*Paragraph*†	*Grade*	*Paragraph*†	*Grade*	*Paragraph*†	
Flooring, Covered	B and Better FG C FG	 136 137	B and Better FG C FG	 536 537					Flat Grain Flooring
Stair Treads, Uncovered	B and Better VG	 109	B and Better VG	 509					Stepping
Stair Treads, Covered	B and Better VG C VG	 109 110	B and Better VG C VG	 509 510					Stepping

TABLE No. 5
EXTERIOR FINISH

USE	DOUGLAS FIR		WEST COAST HEMLOCK		SITKA SPRUCE		WESTERN RED CEDAR		ITEM
	Grade	*Paragraph*†	*Grade*	*Paragraph*†	*Grade*	*Paragraph*†	*Grade*	*Paragraph*†	
Bevel and Bungalow Siding			B and Better C D	 547 548 549	A B C	815 816 817	Clear A B C	935 936 937 938	Bevel and Bungalow Siding
Drop Siding or Rustic	B and Better C D E	141 142 143 145	B and Better C D E	541 542 543 544					Drop Siding or Rustic
Wide Siding	B and Better C D *No. 1	113 114 115 187	B and Better C D *No. 1	513 514 515 587	B and Better C D *No. 1	805 806 807 826	B and Better C D Sound Knotted Paneling No. 1	940 941 942 949 952	Finish or Boards
Battens	Battens	168	Battens	568	B and Better	805	Battens	979	Battens
Exterior Finish and Trim	B and Better C D	113 114 115	B and Better C D	513 514 515	B and Better C D	805 806 807	B and Better C D	940 941 942	Finish
Mouldings	B and Better	171	B and Better	571	B and Better	820	B and Better	972	Moulding
Gutter	B and Better	325							Gutter
Downspout							B and Better	973	Downspout
Porch Floors	B and Better VG C VG	 134 135					B and Better VG C VG	 944 945	Flooring
Stepping	B and Better VG C	 109 110					B and Better VG C	 940 941	Stepping
Risers	B and Better VG C	 113 114					B and Better VG C	 940 941	Finish
Rails and Posts	B and Better	113					B and Better	940	Finish

†All paragraph numbers in this column refer to West Coast Bureau of Lumber Grades and Inspection—Standard Grading and Dressing Rules No. 14.
*Selected for knots.

BOARD FEET IN VARIOUS SIZES OF LUMBER

Size in Inches	*10 ft.*	*12 ft.*	*14 ft.*	*16 ft.*	*18 ft.*	*20 ft.*
1 x 3	2-1/2	3	3-1/2	4	4-1/2	5
1 x 4	3-1/3	4	4-2/3	5-1/3	6	6-2/3
1 x 5	4-1/6	5	5-5/6	6-2/3	7-1/2	8-1/3
1 x 6	5	6	7	8	9	10
1 x 8	6-2/3	8	9-1/3	10-2/3	12	13-1/3
1 x 10	8-1/3	10	11-2/3	13-1/3	15	16-2/3
1 x 12	10	12	14	16	18	20
1-1/4 x 4	4-1/6	5	5-5/6	6-2/3	7-1/2	8-1/3
1-1/4 x 5	5-5/24	6-1/4	7-7/24	8-1/3	9-3/8	10-5/12
1-1/4 x 6	6-1/4	7-1/2	8-3/4	10	11-1/4	12-1/2
1-1/4 x 8	8-1/3	10	11-2/3	13-1/3	15	16-2/3
1-1/4 x 10	10-5/12	12-1/2	14-7/12	16-2/3	18-3/4	20-5/6
1-1/4 x 12	12-1/2	15	17-1/2	20	22-1/2	25
2 x 4	6-2/3	8	9-1/3	10-2/3	12	13-1/3
2 x 6	10	12	14	16	18	20
2 x 8	13-1/3	16	18-2/3	21-1/3	24	26-2/3
2 x 10	16-2/3	20	23-1/3	26-2/3	30	33-1/3
2 x 12	20	24	28	32	36	40
4 x 4	13-1/3	16	18-2/3	21-1/3	24	26-2/3
4 x 6	20	24	28	32	36	40
6 x 6	30	36	42	48	54	60
8 x 8	53-1/3	64	74-2/3	85-1/3	96	106-2/3

SHORT CUT FOR FIGURING RAFTER LENGTHS

In gable roof buildings the rafter length from the plate to the ridge is secured as follows:

On 1/4 pitch—Multiply width of building by .559
On 1/3 pitch—Multiply width of building by .6
On 1/2 pitch—Multiply width of building by .71

To this add whatever length the rafters should extend beyond the plate for the eaves.

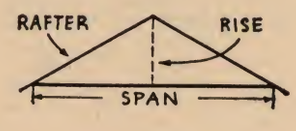
HOW TO FIGURE TONGUE AND GROOVE FLOORING, DROP SIDING, AND SHIPLAP

Calculate square feet in floor; then add as follows:

On 4 in. add 1/4 or 25%
On 6 in. add 1/6 or 16½%
On 8 in. add 1/8 or 12½%
On 10 in. add 1/10 or 10%

HOW TO DETERMINE ROOF PITCH

Roof pitch equals the span divided by the rise.
1/4 pitch is when the rise equals 1/4 the span.
1/3 pitch is when the rise equals 1/3 the span.



CHAPTER 11

PLANNING YOUR BUILDING PROGRAM

Planning the farm building program is *just one part* of a much larger program—a farm life program. To make the building program mean the most, it should be coordinated with all other factors. The overall plan is referred to here as the "American Farmway Life Program."

American Farmway Life Program

Successful farm operators *plan their life programs.* They set *goals of accomplishment* for the whole family, *whether large or small.* By so doing there is the opportunity of guiding the intelligent use of family income.

An ultimate goal can lead to a program with adequate income so that time and energy may be devoted to living a fuller life. Pride, individual initiative, and thrift will predominate where plans are made and carried out.

Plan a complete farm program! Keep it constantly in mind. Such features as the following may well be included:

1. *Systematize farm operations*—Improve the system of

handling each enterprise so the overall effect results in highest profits.

2. *Fit crops to land and market*—The program should work with, and supplement, natural elements—don't fight Nature.

3. *Plan field layout for low-cost crop production*—Consider crop rotation, "clean ground" for hogs and poultry, pasture, drainage and water control, distance from farmstead, and fencing.

4. *Have adequate equipment and power*—Equipment should have a wide range of acreage capacity beyond normal requirements. This will give flexibility in operations to meet changing weather and economic conditions.

5. *Adapt productive livestock to feed and labor available*—Purchase feed only when available labor, profits, and markets justify.

6. *Plan farmstead layout for efficiency and attractiveness*—Make it a labor-saving unit. Keep the boys and girls at home with its attractive efficiency.

7. *Modernize farm improvements for volume production*—Proper layout and design of improvements, that facilitate the handling of crops and livestock under the most efficient *system* known, will permit ease in volume production which is so necessary for profitable and enjoyable farm life.

8. *Plan the use of operating cash*—An estimate of cash income and expenses for each month throughout the year will give a clear picture of the amount of cash available and its intelligent use on permanent structures.

9. *Control farm debt*—The ultimate goal should be no debts, with ample operating capital. A good operator, however, should not hesitate to borrow sufficient capital to carry out a sound program.

10. *Invest in land, buildings and equipment*—Farm operators should keep their funds close to the field with which they are familiar.

11. *Insure property to avoid risk*—Property insurance should be carried to avoid unusual losses that would greatly handicap the farm operations.

Buildings Already Constructed vs. Building New

It is usually more economical to buy a farm with buildings already on the property than to buy a bare piece of land and then construct the desired buildings. Even with the advantage of all new buildings, that conform to specific desired use, the cost normally cannot be justified, in comparison with cost of a farm with buildings.

Remodeling vs. Building New

Considerable cash can usually be saved by remodeling old structures rather than constructing new buildings. Often quite dilapidated structures can be modernized into efficient productive improvements at savings over building new.

Planning Buildings to Fit Crops, Livestock, and Poultry

After considering the many factors of Chapter 2. "Determining Type and Size of Buildings," the next step in planning the building program involves fitting the structures to the crop and livestock systems. By working out the following tables additional space requirements needed will be clearly shown. (Refer to Chapter 9 for crop storage and livestock space requirements and to "Handy Tables" at the end of the book for cubic content of grain and roughage.)

TABLE 1

HOW TO DETERMINE QUANTITY OF CROPS GROWN TO BE STORED EACH YEAR

ESTIMATED YEARLY AVERAGES

Acres	*Kind of Grain or Roughage Crop*	*Average Yield Per Acre*	*Total Yield in Bushels or Tons*	*Estimated Amount to be Stored Each Year. (Production Less Sales at Harvest or Rent Share)*

TABLE 2
HOW TO DETERMINE AMOUNT OF LIVESTOCK PASTURE WILL CARRY

Acres	*Kind of Pasture*	*Number and Kind of Animals Pasture Will Carry Each Season**		*Number and Kind of Animals to use Pasture*	
		No.	*Kind*	*No.*	*Kind*
	Totals				

Not enough pasture, should rent or buy.....acres.
Too much pasture, should rent or sell.....acres.
Not enough livestock, need to purchase.....head.
Too much livestock, should sell.....head.

*Pasture carrying capacity should be approximately 15% larger than requirements to maintain good grazing during low-rainfall seasons.

TABLE 3
HOW TO DETERMINE FEED NEEDED FOR LIVESTOCK AND POULTRY

YEARLY AMOUNTS NEEDED FROM OCTOBER 1 TO THE FOLLOWING SEPTEMBER 30

No.	*Kind of Livestock*	*Protein Supplement*		*Kinds of Grain Needed*				*Roughage Needed*			
		Kind	*Tons*	*Corn Bu.*					*Silage Tons*	*Hay Tons*	*Straw Tons*
Total Feed Needed.....											
Save For Seed.....											
Total Requirement.....											
Less Production (Last Column Table 1).....											
Shortage—Need to Purchase.....											
Overage—Can Use to Replace Shortage or Sell.....											

Grain, not shown above, produced for cash sale requiring storage.....bu. of.....
Roughage, not shown above, produced for cash sale requiring storage.....tons of.....

The only sheathing material with a service record of centuries is wood boards, which combine strength, stiffness, nail-holding capacity, weather-resisting qualities and natural insulation.

TABLE 4

HOW TO DETERMINE AMOUNT OF CROP STORAGE SPACE NEEDED

Kind of Grain or Roughage	*Average Yearly Production Plus Purchases Needing Storage, Plus 10% for Flexibility. Bu. or tons.*	*Storage Space Required in Cu. Ft. (see Handy Tables for Cu. Ft. per Bu. or Ton)*	*Storage Space Available in Present Buildings*		*Additional Cu. Ft. Needed*
			Building	*Cu. Ft.*	

TABLE 5

HOW TO DETERMINE LIVESTOCK AND POULTRY SHELTER

Space Requirements

Kind of Livestock	*Average Numbers to be Sheltered*	*Shelter Space Required or Floor Space in Sq. Ft.**	*Floor Space Available In Present Buildings*		*Additional Floor Space Needed Sq. Ft.*
			Building	*Sq. Ft.*	

*Refer to Chapter 9 for basic space requirements.

HOW TO DETERMINE THE MOST PROFITABLE INVESTMENT IN FARM BUILDINGS

The cost of the building program often makes it necessary to decide which of two buildings, such as hog house or poultry house, will make the most money until funds are available for the second building. Starting with the most needed, or most profitable building, and gradually growing into the final plan, gives the owner a lot of satisfaction.

The following table illustrates a method of determining which building should be constructed first.

EVALUATING FARM BUILDING INVESTMENTS

1	2	3	4	5	6
Kind of Building Needed	*Estimated Cost of Building*	*Amount of End Products Obtained From Use of Buildings Each Year. Bu., Tons; or, Livestock or Poultry Numbers*	*Estimated Profit Per Unit of End Product Per Year*	*Estimated Total Yearly Profit From Use of Buildings. (Column 3 times Column 4)*	*Yearly Profit per Dollar Invested in the Building. (Column 5 divided by Column 2)*
Cattle Shed.....	$1000	25 steers	$20.00	$500	$ .50
1, 4-sow Hog house..	240	56 shoats	5.00	280	1.16
1000 bu. Granary....	300	1000 Bu. Wheat	.10	100	.33

CHAPTER 12

WHO SHOULD BUILD YOUR IMPROVEMENTS

The preceding chapters have been devoted to discussions of basic considerations which will be helpful in planning the number, kind, location, style and type of buildings for the particular requirements of various farm operations. In this chapter are discussed some of the factors involved in deciding who should build them.

PLANNING

This has to do with the actual structural plan or drawings from which a building is erected. The following good sources of plans are readily available and the main features involved in the use of each are outlined.

1. Lumber Dealer:
   (a) Has wide variety of standard plans, usually free.
   (b) Can help select plan to make use of readily available and low-cost materials.
   (c) Is reliable. Lumber manufacturers furnishing plans are interested in seeing satisfactory buildings constructed.
2. County Agricultural Agents and Agricultural Extension Service of State Agricultural Colleges:
   (a) Can secure plans from all sources.
   (b) Often have sample plans on hand for inspection.
   (c) Can advise types best adapted to local conditions.
3. Agricultural Engineers of State Agricultural Colleges:
   (a) Many plans available free or for a small cost.
   (b) Some include well-worked-out material lists and specifications.
   (c) Give unbiased information on building construction.
4. Professional Farm Managers:
   (a) Have practical plans that have been tested on actual farm operations.
   (b) Have given a great deal of study and application to the proper type and use of buildings for improving efficiency.
   (c) Have the facilities for seeing many types of buildings in use under different situations.
5. Builders or Contractors:
   (a) Useful in selecting plans for buildings for which they have equipment and "know how" to build readily.
   (b) Some will make drawings, material lists, and specifications at little or no cost.
6. Practicing Architects:
   (a) Ordinarily do not feature farm buildings.
   (b) Most valuable for planning houses to meet individual requirements.
   (c) Also valuable to make desired alterations in standard plans obtained elsewhere.

Thousands of dollars are spent by these sources in preparing plans which are usually available without cost, or for a reasonable charge.

SELECTION AND PURCHASE OF MATERIALS

The following considerations should govern the selection and purchase of materials:

1. Use the materials specified in the plan selected or make certain that alternative materials are satisfactory.
2. Buy from reliable local dealers.
3. Recognize different grades of material suitable for different purposes and use accordingly.

ERECTION

Major farm buildings usually should be erected by a professional builder. He is a specialist in his line, the same as a farmer is a specialist in his. A farm operator can usually make more money by devoting himself to his job and hiring whatever he needs to have done in some other line. However, the farmer can do some of the work and reduce cash outlay by using his tools and equipment.

Sources of Labor for Farm Building

The first consideration on erection is the source of labor. There are three alternatives and the major factors in connection with each are:

1. Professional Builder
   (a) Usually builds faster and better.
   (b) Costs more but usually worth the difference.
2. Farm Labor
   (a) Only advantage is saving in cost.
   (b) Can use labor at off-peak seasons.
3. Combination of Professional Builder and Farm Labor
   (a) Gives advantage of both.
   (b) Better job with some saving in cost.

Relationship With Builder

The three customary ways of hiring labor for farm buildings and the important considerations in connection with each are:

1. Lump sum contracts (wherein a builder agrees to erect a building for so much money).
   (a) Requires complete detailed plans.
   (b) Requires written specifications.
   (c) Requires written material lists.
   (d) Requires diligent inspection by owner.
2. Cost Plus Contract (wherein owner pays for material and labor plus a fixed percentage to contractor.)
   (a) Owner should check amounts and prices of material.
   (b) Owner should check amounts and wages of labor.
   (c) Probably the fairest method and least susceptible to misunderstanding.
3. Owner buys material and hires labor.
   (a) Best adapted for use of farm labor.
   (b) Requires more supervision by owner.
   (c) Most flexible in allowing alterations.

FINANCING FARM BUILDINGS

Construction of major farm buildings sometimes involves cash expenditures somewhat larger than should be taken out of operating capital. In this event special financing is advisable. There are several types of financing for farm buildings. They are:

1. Bank Credit
   Satisfactory where repayment can be made within 6 to 12 months.
2. Lumber companies
   Good where repayment may be made in installments over 1 to 3 years.
3. Mortgage on the farm
   For houses, barns, and complete sets of buildings involving large amount of funds. Existing mortgages may often be increased to cover amounts needed.
4. Government Loans
   Federal Housing Administration—principally for houses.
   Farm Security Administration—mainly to get started farming.
   Federal Land Bank—regular mortgages. G. I. Bill—for returning veterans.

INSURANCE

The investment in farm buildings should be protected by adequate fire, lightning, and windstorm insurance in reliable companies. Eighty per cent (80%) of the building value is considered a satisfactory amount from the standpoint of both the owner and insurance company.

Some insurance companies issue policies under certain restrictions of use and occupancy. Owners should thoroughly understand the terms of insurance policies.

Insurance may also be had on building contents. If possible coverage should be in the same policy as the building or at least with the same company. In the event of loss it is easier to adjust with one company than with several.

TAXES

Buildings are assessed for property taxes but the assessment is usually combined with that of the land. Aside from the fact that a well-improved farm is assessed higher per acre than a poorly improved one, the buildings themselves have very little effect on property taxes. The depreciation on buildings, however, has very decided effect on income tax and should be deducted as a yearly operating expense. The following typical depreciation rates are allowed by the Internal Revenue Department:

TYPICAL DEPRECIATION RATES

20%	10%	5–10%	4–10%	3–5%	2–5%
*Lime or Phosphate	Fences	Silo, wood Scales Windmills Water storage tanks, wood Cesspools Terraces Orchards and Vines	Frame Buildings Garages Barns Cribs Hog houses Granaries Poultry houses Sheds Others	House, frame** Brick, tile, concrete and metal buildings Barns Silo Water storage Others	Wells Tile Ponds Dams Roads

*Lime or rock phosphate may be charged as current expenses where a definite program calls for applying some each year.
**No depreciation allowable on owners' personal residence.

"Ordinary stud and plate walls sheathed diagonally are 4 to 7 times as stiff and 7 to 8 times as strong as if horizontally sheathed." Iowa State College Circular No. 127.

HANDY TABLES

TABLES OF WEIGHTS AND MEASURES

LIQUID MEASURE

4 gills (gi.)	1 pint (pt.)
2 pints	1 quart (qt.)
4 quarts	1 (gal.)
31½ gals	1 (bbl.)
2 barrels	1 hogshead
7½ Gal. water	1 cu. ft. approx.
1 U. S. gallon	231 cu. in.
1 Gal. milk	8.6 lbs. approx.

DRY MEASURE

2 pts.	1 quart (qt.)
8 qts.	1 peck (pk.)
4 pks.	1 bushel (bu.)
1 bushel	2,150.42 cu. in.

SQUARE MEASURE—AREA

9 sq. ft.	1 sq. yd.
272.25 sq. ft.	1 sq. rod
30.25 sq. yds.	1 sq. rod
160 sq. rods	1 acre
43,560 sq. ft.	1 acre
640 acres	1 sq. mi.

LINEAR MEASURE

12 inches (in.)	1 foot (ft.)
3 feet	1 yard (yd.)
5½ yds. or 16½ ft.	1 rod
320 rods	1 mile (mi.)
1 mile	1,760 yds. or 5,280 ft.

SOLID OR CUBIC MEASURE

1,728 cu. in.	1 cu. ft.
27 cu. ft. or 46,656 cu. in.	1 cu. yd.
24¾ cu. ft. equals	1 perch
128 cu. ft. or 8′x 4′x 4′	1 cord
1′x 1′x 1″ equals	1 board foot
1.25 cu. ft. of small grain	1 bushel
2.25 cu. ft. of good, clean, dry, hybrid ear corn	1 bushel
2.5 cu. ft. average ear corn	1 bushel
3.0 cu. ft. of snapped corn	1 bushel
3.0 to 3.5 cu. ft. (approx.) of soft ear corn (20 to 25% moisture)	1 bushel*

*Use this as an inventory guide only. Cubic content per bushel is greatly affected by the maturity of corn. The cubic content of immature corn, running higher than 25% moisture, may be greater than 3.5.

CAPACITY OF CISTERNS, TANKS OR ANY CYLINDER

3.1416 times radius squared, times height in feet equals _____ cu. ft., times { .4 equals bu. ear corn; .8 equals bu. shelled corn or small grain; 7.5 equals gallons

HOW TO FIGURE WATER REQUIREMENTS FOR THE HOME AND FARMSTEAD

Use this table in figuring the amount of water needed per day

Water For	*Amount of Water Per Day*
Each member of the family for all purposes, including bath, water closet, kitchen and laundry	50 gallons
Each horse	12 gallons
Each steer or dry cow	12 gallons
Each milk producing cow	20 gallons
Flushing stables and washing dairy utensils	20 gallons
Each hog	4 gallons
Each sheep	2 gallons
100 chickens	6 gallons
Sprinkling lawn or garden 1″ depth per 100 sq. ft.	62 gallons
½ in. hose with nozzle—per hour	200 gallons
¾ in. hose with nozzle—per hour	300 gallons

SIZES OF EAVES-TROUGHS AND DOWNSPOUTS FOR VARIOUS ROOF AREAS

Roof area (square feet)	*Eaves-trough Diameter*	*Down-spout Diameter*
	Inches	*Inches*
100-800	4	3
800-1,000	5	3
1,000-1,400	5	4
1,400-2,000	6	4

U.S.D.A.

Additions, alterations and improvements can be made most easily and least expensively if the original building is wood.

Wood construction is the standard for farm buildings. It has been time-tested and has proved to be a sound, profitable investment.

AVERAGE WEIGHT OF ONE QUART OF FEED IN POUNDS

FEED	*Weight*
Corn, unground	1.75
Corn meal	1.31
Hominy feed	1.50
Gluten feed	1.50
Gluten meal	1.65
Germ oil meal	1.35
Distillers' dried grain	0.63
Corn and cob meal	1.50
Oats, unground	1.03
Oat meal	1.67
Wheat, whole	1.90
Wheat, bran	0.56
Wheat, middlings	1.00
Flour middlings	1.19
Rye, unground	1.85
Rye, middlings	1.35
Barley, unground	1.01
Brewers' dried grains	0.67
Buckwheat middlings	0.92
Buckwheat, unground	1.43
Flaxseed, unground	1.65
Flaxseed meal	1.10
Linseed meal, old process	1.33
Cottonseed meal	1.50
Blood meal	1.87
Alfalfa meal	0.59
Dried beet pulp	0.65
Canada field peas	2.09
Field beans	1.71
German millet seed	1.59
Soybeans	1.51
Sunflower seed	1.51

WEIGHTS OF FEED

Kind of Feed	*Pounds*	
	Per cu. ft.	*Per bu.*
ROUGHAGE		
Loose Hay:		
In shallow mows	4	
In deep mows	4½	
Baled Hay:		
Loose Bales	10	
Ordinary Bales	12 to 14	
Very tight Bales	20 to 25	
Chopped Hay	8 to 12	
Straw (ordinary bales)	10 to 12	
MILL FEED		
Bran	13	
Middlings	25	
Linseed or soybean meal	30 to 40	
GRAIN		
Corn:		
Shelled	45	56
Ear	28	70
Snapped	24	80
Oats	26	32
Barley	39	48
Wheat	48	60
Rye	45	56

ESTIMATING GRAIN IN STORAGE

Earn Corn. . . . . Multiply:_____ft. long times_____ft. wide times_____ft. high times .4 equals _____bu. ear corn.

Ear corn—round crib . . Multiply:_____ft. around crib times_____ ft. diameter times_____ft. high divided by 10 equals_____bu. ear corn.

Grain and Shelled corn. Multiply:_____ft. long times_____ft. wide times_____ft. high times .8 equals _____bu. grain or shelled corn.

WHITEWASH THAT STICKS

Directions for making whitewash are as follows:

Slake two pecks of lime with boiling water, adding the water slowly and stirring constantly until a thin paste results. If water is added too rapidly, or if the mixture is not well stirred the paste will be lumpy.

Add one gallon of salt to the lime paste and stir thoroughly. Add water to bring the whitewash to the proper consistency for spraying.

Just before using, add to each pailful of whitewash a handful of Portland cement and a teaspoonful of ultramarine bluing. Adding these materials earlier will cause the whitewash to appear streaked.

The cement makes the whitewash adhere strongly to any surface, whereas the bluing counteracts the grayish color of the cement and results in the snow-white appearance so much desired.

HOW TO FIGURE AMOUNTS OF PAINT REQUIRED FOR FARM BUILDINGS

Kind of Wood	*Coverage in Square Feet per Gallon of Paint*		
	For First Coat	*For Second Coat*	*For Two Coats*
For rough old dry lumber	175	300	120
Old dry checked lumber	250	350	150
Medium dry old lumber, very poor paint, not badly checked	300	400	175
Old bldgs., paint still fair	400	600	250
New lumber	400	600	250

Wood is most adaptable to remodeling and salvage. Hence wood structures are less expensive both in first cost and in maintenance.

Nearly all small farm structures can be safely built of the lower grades of lumber with ample strength and important savings in cost.

COVERING CAPACITIES AND APPROXIMATE NAIL REQUIREMENTS OF CERTIGRADE RED CEDAR SHINGLES

(Including the number of square feet covered by four-bundle squares, and single bundles for exposure given, as well as nail quantities required for each exposure.)

Shingle Exposure in Inches	No. 1 GRADE SIXTEEN INCH SHINGLES — NAIL SIZE: 3d, 1-1/4 inch long				No. 1 GRADE EIGHTEEN INCH SHINGLES — NAIL SIZE: 3d, 1-1/4 inch long				No. 1 GRADE TWENTY-FOUR INCH SHINGLES — NAIL SIZE: 4d, 1-1/4 inch long			
	Four-Bundle Square		One-Bundle		Four-Bundle Square		One-Bundle		Four-Bundle Square		One-Bundle	
	Coverage in Sq. Ft.	Pounds Nails	Coverage in Sq. Ft.	Pounds Nails	Coverage in Sq. Ft.	Pounds Nails	Coverage in Sq. Ft.	Pounds Nails	Coverage in Sq. Ft.	Pounds Nails	Coverage in Sq. Ft.	Pounds Nails
3-1/2	70	2-7/8	17-1/2	3/4								
4	80	2-1/2	20	5/8	70	2-1/2	17-1/2	5/8				
4-1/2	90	2-1/4	22-1/2	5/8	80	2-1/4	20	5/8				
5	*100**	2	*25*	1/2	90	2	22-1/2	1/2				
5-1/2	110	1-3/4	27-1/2	1/2	*100**	1-3/4	*25*	1/2				
6	120	1-2/3	30	3/8	108	1-2/3	27	3/8	80	2-1/3	20	5/8
6-1/2	130	1-1/2	32-1/2	3/8	117	1-1/2	29	3/8	90	2-1/8	22-1/2	1/2
7	140	1-2/5	35	1/3	127	1-2/5	31	1/3	95	2	24	1/2
7-1/2	†*150*	1-1/3	*37-1/2*	1/3	136	1-1/3	34	1/3	*100**	1-7/8	*25*	1/2
8-1/2					154	1-1/4	38	1/4				
11									†*147*	1-1/4	*36-1/2*	1/3
12	‡*240*		*60*									
14					‡*254*		*63*					
16									‡*212*		*53*	

*Maximum exposure recommended for roofs.
†Maximum exposure recommended for single-coursing on side walls.
‡Maximum exposure recommended for double-coursing on side walls.

In double-coursing, with any exposure chosen, the figures indicate the amount of shingles for the outer courses. Order an equivalent number of squares or bundles of No. 2 or No. 3 shingles for the concealed courses.

SHINGLES AND NAILS REQUIRED FOR OVER-ROOFING (100 square feet roof area):

	Bundles	Size Nails	Weight Nails
16-inch shingles, 5 inch exposure	4	5d (1¾-inch)	3-1/3 lbs.
18-inch shingles, 5½ inch exposure	4	5d (1¾-inch)	3 lbs.
24-inch shingles, 7½ inch exposure	4	6d (2 -inch)	3-1/3 lbs.

SHINGLES AND NAILS REQUIRED FOR DOUBLE-COURSING (100 square feet wall area):

	Bundles	Size Nails	Weight Nails
No. 1—16-inch shingles, 12 inch exposure	1-2/3	5d* (1¾-inch)	1⅛ lbs.
No. 2—16-inch shingles, undercourse	1-2/3	3d (1¼-inch)	⅝ lb.
No. 1—18-inch shingles, 14-inch exposure	1-3/5	5d* (1¾-inch)	1 lb.
No. 2—18-inch shingles, undercourse	1-3/5	3d (1¼-inch)	½ lb.
No. 1—24-inch shingles, 16-inch exposure	1-7/8	5d* (1¾-inch)	⅞ lb.
No. 2—24-inch shingles, undercourse	1-7/8	3d (1¼-inch)	⅜ lb.

*Small Headed.

Important saving can be made in lumber costs by proper use of the lower grades of lumber.

NAILS—QUANTITIES AND INSTRUCTIONS

	Size of Nails	Nails each Bearing	Length of Nail	Gauge	Nails Per Lb.	Lbs. Required 1000 Bd. Ft. 24"c.	16"c.	12"c.	Lb.	Instructions
1 x 4 Boards and Shiplap.	8d Common (or box)	2	2½	10¼	106	30	48	60		
1 x 6 Boards and Shiplap.	8d Common (or box)	2	2½	10¼	106	20	32	40		
1 x 8 Boards and Shiplap.	8d Common (or box)	2	2½	10¼	106	16	26	31		
1 x 10 Boards and Shiplap.	8d Common (or box)	2	2½	10¼	106	13	20	25		
1 x 12 Boards and Shiplap.	8d Common (or box)	3	2½	10¼	106	16	24	31		
Base	8d Finish	2	2½	12½	189				1	Per 100 Lin. Ft.
Battens	4d Finish		1½	15	584				.5	Per 100 Lin. Ft.
Bridging	8d Common (or box)		2½	10¼	106	.9	1.2	1.5		4 Nails each piece.
Ceiling ½ or ⅝ x 4	6d Finish	1	2	13	309	6	8	11		
Ceiling ¾ x 4	8d Finish	1	2½	12½	189	9	14	18		
Finish, 1"	8d Finish	2	2½	12½	189	13	12	25		
Finish, 1¼"	10d Finish	2	3	11½	121	6	10	12		
Flooring 1 x 3 Soft Wood	8d Casing	1	2½	11½	145	21	32	42		
1 x 4 Soft Wood	8d Casing	1	2½	11½	145	16	24	30		
1 x 6 Soft Wood	8d Common (or box)	1	2½	10¼	106	11	16	22		
⅜ x 1½ Hard Wood	4d Casing	1	1½	14	473		10	13		Nail every 10" to 12"
⅜ x 2 Hard Wood	4d Casing	1	1½	14	473		8	11		Nail every 10" to 12"
13/16 x 2¼ Hard Wood	8d Casing	1	2½	11½	145		14	20		Nail every 14" to 16"
13/16 x 1½ Hard Wood	8d Casing	1	2½	11½	145		20	27		
Furring										
1 x 2 on Brick Walls	20d Common Cut Nails								5.25	Per 100 Lin. Ft.
Framing										
2 x 4 to 2 x 12	20 d Common		4	6	31	10	15	20		
	16d Common (or box)		3½	8	49	6	8	10		
	10d Common (or box)		3	9	69	4	6	8		
Girders—Built Up										
2 x 6	16d Common (or box)		3½	8	49				2.0	Per 100 Lin. Ft. 30 pounds
2 x 8	16d Common (or box)		3½	8	49				2.8	Per 100 Lin. Ft. Mixed 16d
2 x 10	16d Common (or box)		3½	8	49				3.5	Per 100 Lin. Ft. or/and 20d Common
2 x 12	16d Common (or box)		3½	8	49				4.2	Per 100 Lin. Ft. Per M
Joist, Flooring and Ceiling										
2 x 6 and 2 x 8	16d Common (or box)		3½	8	49	13	18	22		
2 x 10 and 2 x 12	16d Common (or box)		3½	8	49	14	15	16		
Wood Lath	3d Fine	1	1⅛	15	778				7	Per 1000 Lath
Plywood										
1/4 inch	4d Common (or box)		1½	12½	316	5.4	6.1	6.8		Space nails at 6" on plates and outside studs and 12" on intermediate studs. Place nails 3/8" from panel edge.
1/4 inch	4d Finish (or box)		1½	15	584	2.9	3.3	3.7		
5/16 inch, 3/8 inch	6d Common* (or box)		2	11½	181	9.5	10.7	11.9		
3/8 inch	6d Finish* (or box)		2	13	309	5.6	6.3	7.0		
1/2 inch	6d Common* (or box)		2	11½	181	9.5	10.7	11.9		
5/8 inch, 3/4 inch	8d Common* (or box)		2½	10¼	106	16.2	18.3	20.3		

NOTE.—When nailing ¼ inch Plywood it will require about 3½ pounds per 1000 square feet of 4d finish nails or 7 pounds of 4 inch flat head nails where battens are not used; and about 6 pounds of 4d flat head nails together with 2 pounds of 4d finish nails where battens are used to cover joints spaced 4 feet 0 inches apart.

*Preferably cement coated nails.

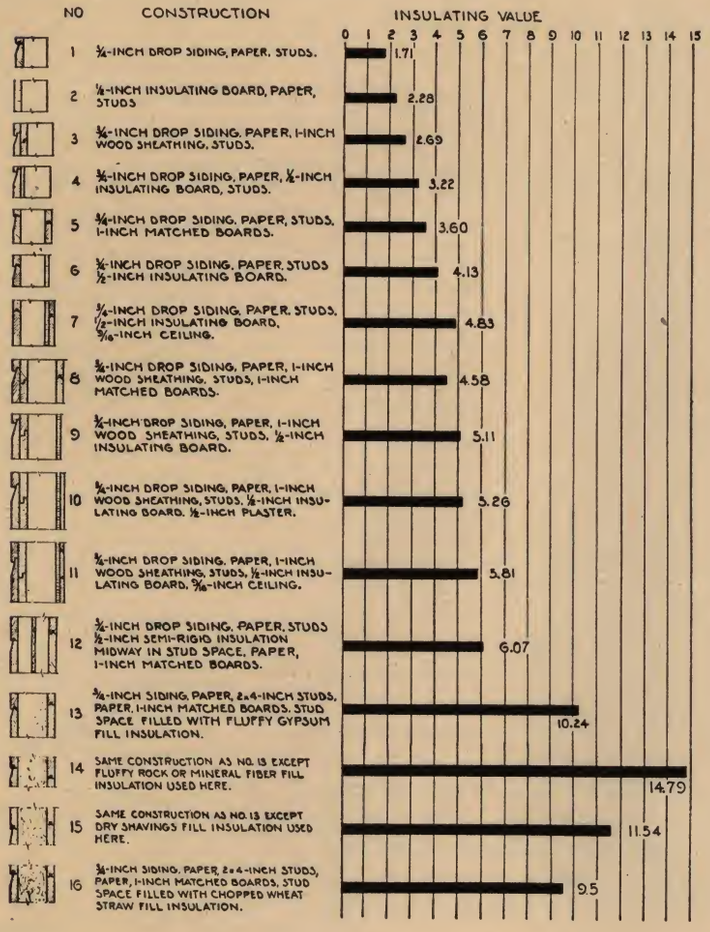
Shingles—Roof and Siding
See separate Table, "Covering Capacities and Approximate Nail Requirements of Certigrade Red Cedar Shingles."

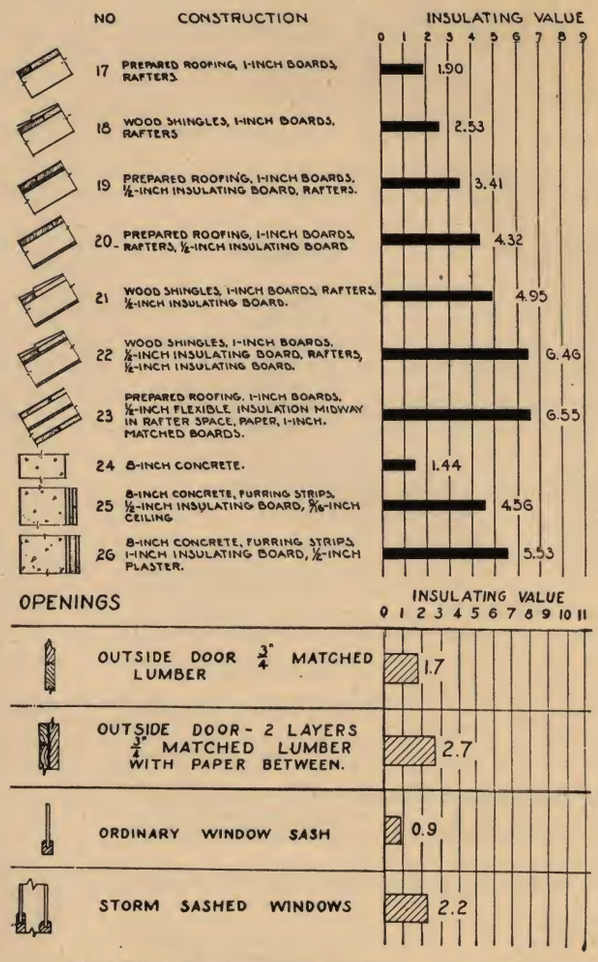
Siding—Bevel										
1/2 x 4	6d Box	1	2	12½	236		18	23		
1/2 x 6	6d Box	1	2	12½	236		15	15		
1/2 x 8	6d Box	1	2	12½	236		10	12		
3/4 x 10	7d Box	2	2¼	12½	210		35	45		
3/4 x 12	7d Box	3	2¼	12½	210		50	60		
Siding, Drop										
1 x 4	7d Box	2	2¼	12½	210	22	35	45		
1 x 6	7d Box	2	2¼	12½	210	15	23	30		
Studding										
2 x 4 Mixed	16d Common (or Box)		3½	8	49				15	Per 1000 Bd. Ft.
2 x 6	8d Common (or box)		2½	10¼	106				15	Per 1000 Bd. Ft.
Trim—Side of Door and Window	4d Finish		1½	15	584				.5	Per Side of Trim
	6d Finish		2	13	309				.5	Per Side of Trim
	8d Finish		2½	12½	189				.5	Per Side of Trim

Based on table from "American Lumberman and Building Products Merchandizer."

INSULATING VALUE OF COMMON CONSTRUCTION

The relative insulating values of various walls, roofs, and opening panels are shown in the table below. Attention is called to the use of asphalt *waterproof paper* as a moistureproof barrier. It is very important to place a moisture barrier in the wall on the *warm* side of the insulation to eliminate the accumulation of moisture through condensation. Continued absorption of moisture by the insulation will destroy its effectiveness, cause the paint to peel off, and finally result in deterioration of the structure.





North Dakota Agricultural College, U.S.D.C., and Ohio State University

CAPACITIES AND DIMENSIONS, FOR SEPTIC TANKS SERVING INDIVIDUAL DWELLINGS

Maximum number of persons served	*Liquid capacity of tank in gal.*	*Recommended inside dimensions*			
		Width	*Length*	*Liquid depth*	*Total depth*
4 or less	500	3′-0″	6′-0″	4′-0″	5′-0″
6	600	3′-0″	7′-0″	4′-0″	5′-0″
8	750	3′-6″	7′-6″	4′-0″	5′-0″
10	900	3′-6″	8′-6″	4′-0″	5′-0″
12	1100	4′-0″	8′-6″	4′-6″	5′-6″
14	1200	4′-0″	9′-0″	4′-6″	5′-6″
16	1500	4′-6″	10′-0″	4′-6″	5′-6″

(Farmers' Bulletin No. 1950)

"Wood possesses the best insulating properties of any of the basic structural materials now commonly used," says the Forest Products Laboratory, U. S. Dept. of Agriculture.

SEWAGE DISPOSAL REQUIREMENTS

Farm sewage disposal systems are not difficult to install. Those portions of the system leading from plumbing fixtures to the outside of the house should be understood before the work begins or installed by a competent plumber. Portions outside may be installed by ordinary labor. The following basic requirements for sewage disposal will serve as a guide for installation of both portions:

Water to be handled	50 Gal. per person per day
From sink, bath tub, lavatories	2″ soil pipe (cast iron)
From stool (install close to main sewer line)	4″ soil pipe (cast iron)
Sewer main extending 5′ outside house	4″ or 6″ soil pipe (cast iron)
Sewer main 5′ from house to tank	4″ or 6″ vitrified clay or soil pipe
Sewer tile tank to distribution box	4″ vitrified clay, cast iron, or impregnated fiber
Sewage disposal tile	4″ unglazed drain tile
Distance septic tank from house	16 to 20 feet, farther if there is ⅛″ to ¼″ slope per foot
Distance septic tank from drinking well	50 ft. or more and at lower surface elevation
Joints for vitrified clay tile tightly cemented	Mortar: one part cement, two parts sand by measure
Joints for disposal drain tile	Cover upper half of joints with asphalt paper to keep out dirt
Near trees	4″ soil pipe—leaded
Slope—Drain tile to tank	⅛″ to ¼″ per ft.
Slope—Tank to distribution box	⅛″ to ¼″ per ft.
Slope—Distribution box to dipsosal field	2″ to 6″ per 100 lineal ft.
Tank capacity	8 cu. ft. per person (allow plenty. Large tank not objectionable.) Minimum volume 65 cu. ft.
Tank dimensions	5 ft. depth of liquid, minimum 4 ft. (others optional)
Type of tank most economical to install	1 chamber
Inlet at tank	Not necessary to be below frost line, approximately 1 to 2 ft. below ground surface
Inlet at inside of the tank	6″ to 12″ below surface of liquid
Outlet inside of the tank	10″ to 16″ below surface of liquid
Outlet at tank	2″ to 3″ below inlet
Outlet slope	4″ in first 5 ft. then 2″ to 4″ per 100 lineal ft. but total to exceed 6″
Open outlet	Have not over 500 ft., 4″ drain tile. If soil not suited for disposal field, have slope 2 ft. per 100 lineal ft. for open outlet.
Absorption outlet	25 to 50 ft. tile per person, minimum 300 ft.; 3 to 4 ft. deep. (Use only in porous soil; for tight soils see U.S.D.A. Farmers' Bulletin 1950.)
Clean tank	Every 5 to 10 years when sludge reduces liquid depth to three feet.

SAFE DEPTH OF WHEAT IN BINS WITH JOISTS OF COMMON SIZES FOR LENGTHS INDICATED*

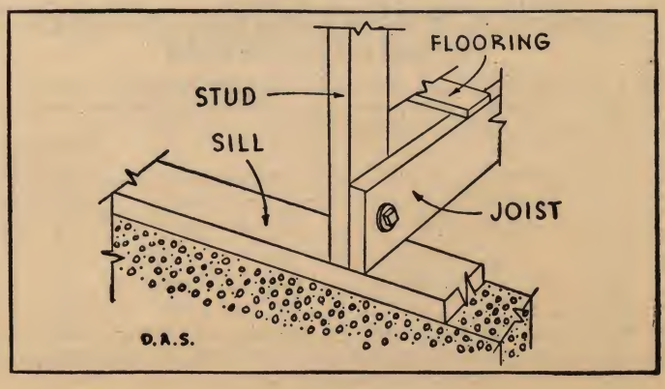
JOISTS SUPPORTED AT ENDS ONLY

Size of Joist (inches)	*Length of Joist* 6-Foot	8-Foot	9-Foot	10-Foot
24-inch Spacing				
	Feet	*Feet*	*Feet*	*Feet*
2 x 6	3	—	—	—
2 x 8	4½	3	—	—
2 x 10	6	4	3½	3
2 x 12	8	5	4½	4
16-inch Spacing				
2 x 6	4½	—	—	—
2 x 8	6½	4½	3½	3
2 x 10	9½	7	5½	4½
2 x 12	12	8	7	6
12-inch Spacing				
2 x 6	6	—	—	—
2 x 8	9	6	5	—
2 x 10	12	8½	7½	6
2 x 12	16	11	9½	8

JOISTS SUPPORTED AT EACH END AND AT CENTER

24-inch Spacing				
2 x 6	4½	3¼	—	—
2 x 8	6	4¼	3½	—
2 x 10	8	5½	4¼	3½
2 x 12	10¼	6¾	5¼	4¼
16-inch Spacing				
2 x 4	4¼	3	—	—
2 x 6	7	4¾	3¾	3¼
2 x 8	9¾	6½	5¼	4¼
2 x 10	13¼	8¾	6½	5½
2 x 12	16¾	11½	8	6½
12-inch Spacing				
2 x 4	6	4¼	—	—
2 x 6	9¾	6½	5¼	4¼
2 x 8	14¼	9¼	7	5¾
2 x 10	19¼	12½	9	7¼
2 x 12	24¼	15¾	11½	9

*U.S.D.A.



SAFE DEPTH OF WHEAT IN BINS WITH STUDS OF COMMON SIZES AND SPACINGS*

Size of Studs	Spacing center to center	Depth of bin	Depth of Wheat	Size of Studs	Spacing center to center	Depth of bin	Depth of Wheat
Inches	*Inches*	*Feet*	*Feet*	*Inches*	*Inches*	*Feet*	*Feet*
2 x 4	24	8	4	2 x 6	24	8	7
2 x 4	16	8	6	2 x 6	16	10	8
2 x 4	12	8	7	2 x 6	12	10	9

*U.S.D.A.

SIZE AND SPACING OF JOISTS FOR OVERHEAD BINS*

Width of Driveway	SAFE DEPTH OF GRAIN							
	4 feet		6 feet		8 feet		10 feet	
	Size of Joists	Maximum spacing of Joists	Size of Joists	Maximum spacing of Joists	Size of Joists	Maximum spacing of Joists	Size of Joists	Maximum spacing of Joists
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
9 feet	2 x 8	12	2 x 10 2 x 12	12 16	2 x 12 3 x 12	12 18	3 x 12	16
10 feet	2 x 8 2 x 10	12 16	2 x 12	12	3 x 12	16	Two 2 x 12	18
11 feet	2 x 10 2 x 12	12 18	2 x 12	12	3 x 12	12	3 x 12	12

*U.S.D.A.

SPACE REQUIRED BY STANDARD BOXED APPLES

	Packed	Loose
Height	1.02 feet	.91 feet
Width	1.13 feet	1.03 feet
Length	1.63 feet	1.63 feet
Length required for 3″ spacing	1.88 feet	1.88 feet
Net cubic feet per box, 3″ spacing	2.12 cu. ft.	1.93 feet

In estimating gross space required in a storage room, allowance must be made for aisle space, conveyors, wall ceiling clearance, duct or piping space, and other space not actually usable for boxes. Making these allowances, a gross space of 2.5 to 2.7 cubic feet per box is sometimes used.

(Agricultural Research Administration, U.S.D.A.)

APPROXIMATE REFRIGERATION REQUIRED FOR DELICIOUS APPLES

For receiving 1000 boxes daily and cooling fruit to 32° F. in seven days. (Allowance for open doors, workmen, motors, etc., may increase this requirement by 15 or 20%.)

Initial Fruit Temperature	Tons of Refrigeration
55° F.	4.9
65° F.	6.9
75° F.	8.8
85° F.	10.8

For holding, after reaching 32° each 1000 boxes requires about .07 T. One ton of refrigeration will care for about 15,000 boxes.

(Agricultural Research Administration, U.S.D.A.)

AVERAGE FREEZING TEMPERATURES OF VARIOUS FRUITS

Commodity	Degrees Fahr.
Apples	
Delicious	28.36
Jonathan	28.35
Winesap	28.24
Pears	
Bartlett hard ripe	28.5
Bartlett soft ripe	27.8
Anjou hard ripe	26.9
Anjou soft ripe	27.2
Cherries	
Bing—mature (black)	24.1
Bing—immature (black red)	25.3
Sour	28.0
Peaches	
Elberta	29.7
J. H. Hale	29.6

Agricultural Research Administration, U.S.D.A.

SPACE REQUIRED FOR FROZEN FRUIT

Fruit	Storage space required per bu. of fresh fruit when frozen and packaged
Apples	.92 cu. ft.
Peaches	.62 cu. ft.

CAPACITIES OF ROUND SILOS IN TONS

The following table may be used for any silo in which the silage has settled for thirty days or more when measurement of depth of silage is taken. Silage does not settle after the first thirty days.

For corn ensiled when less mature than usual, add 10 to 15 per cent to the capacity given. If corn is unusually rich in grain, add 5 to 10 per cent. If corn is unusually dry when ensiled, deduct 10 to 15 per cent. If very little grain is present, deduct 10 per cent.

Depth of Silage in feet	*10-ft. Diameter*	*12-ft. Diameter*	*14-ft. Diameter*	*16-ft. Diameter*	*18-ft. Diameter*	*20-ft. Diameter*
	TONS	*TONS*	*TONS*	*TONS*	*TONS*	*TONS*
1	1.3	1.8	2.5	3.2	4.1	5.0
2	2.5	3.7	5.0	6.5	8.2	10.2
3	3.9	5.5	7.6	9.9	12.5	15.4
4	5.2	7.5	10.2	13.3	16.8	20.8
5	6.6	9.5	12.9	16.8	21.2	26.2
6	7.9	11.4	15.6	20.3	25.7	31.8
7	9.4	13.5	18.4	24.0	30.3	37.5
8	10.8	15.6	21.2	27.7	35.0	43.2
9	12.3	17.7	24.0	31.4	39.7	49.0
10	13.7	19.8	27.0	35.2	44.5	55.0
11	15.3	22.0	29.9	39.0	49.3	61.0
12	16.8	24.2	32.9	42.9	54.3	67.1
13	18.3	26.4	35.9	46.9	59.3	73.3
14	19.9	28.7	39.0	50.9	64.4	79.6
15	21.4	30.9	42.0	54.9	69.3	85.7
16	23.1	33.2	45.2	59.0	74.6	92.2
17	24.6	35.5	48.3	63.0	79.7	98.5
18	26.2	37.8	51.4	67.1	84.8	104.8
19	27.8	40.1	54.6	71.2	90.0	111.3
20	29.5	42.4	57.8	75.4	95.3	117.8
21	31.0	44.7	60.8	79.4	100.3	124.0
22	32.7	47.0	64.0	83.6	105.6	130.5
23	34.3	49.4	67.3	87.8	110.5	137.2
24	35.9	51.1	70.4	91.9	116.1	143.6
25	37.6	54.2	73.7	96.2	121.6	150.3
26	39.2	56.5	76.9	100.3	126.8	156.8
27	40.9	58.9	80.2	104.7	132.4	163.6
28	42.6	61.3	83.4	108.8	137.6	170.1
29	44.3	63.7	86.9	113.4	143.3	177.1
30	45.9	66.1	90.1	117.6	148.6	183.7
31	47.6	68.5	93.4	121.1	154.1	180.9
32	49.3	70.9	96.7	126.2	159.5	196.2
33	51.0	73.4	100.0	130.5	165.0	202.4
34	52.7	75.8	103.3	134.8	170.5	208.0
35	54.4	78.2	106.6	139.1	175.9	214.9
36	56.1	80.7	110.0	143.5	181.4	221.2
37	57.8	83.1	113.3	147.8	186.9	227.4
38	59.5	85.8	116.6	152.1	192.4	233.7
39	61.2	88.0	119.9	156.4	197.8	239.9
40	62.8	90.4	123.2	160.7	203.3	246.2
41	64.5	92.8	126.5	165.0	208.8	252.4
42	66.2	95.2	129.8	169.3	214.2	258.6
43	67.9	97.7	133.1	173.6	219.7	264.9
44	69.6	100.1	136.4	177.9	225.2	271.2
45	71.3	102.7	139.7	182.2	230.6	277.4

(Kansas State College, University of Illinois, University of Missouri.)

CAPACITY OF TRENCH SILOS

To compute the capacity of any trench silo, first figure the cubic feet in one foot of length by multiplying the average width by the depth. Here is an example: For a silo with a top width of 12 feet, a bottom width of 8 feet, and a depth of 8 feet, multiply half the sum of the top and bottom widths, which is 10 feet, by the depth of 8 feet. This will give 80 cubic feet per foot of length. Thus, the capacity of a silo 40 feet long would be 80 x 40, or 3,200 cubic feet. If the trench has one or both ends sloping, include only half the lengths of the slopes. To determine the capacity in pounds, multiply the cubic feet by 35. Thus, the silo with dimensions as given above will hold 3,200 x 35, equalling 112,000 pounds, or 56 tons. For a convenient approximate rule, divide the cubic feet by 60 to determine the capacity in tons.

CAPACITY OF SILO IN CUBIC FEET AND IN POUNDS PER FOOT OF LENGTH OF SETTLED SILAGE.

(*Silage weight figured at 35 pounds per cubic foot.*)

	Depth of silo in feet									
	6		*7*		*8*		*9*		*10*	
Average width, feet	*Cu. ft.*	*Lbs.*	*Cu. ft.*	*Lbs.*	*Cu. ft.*	*Lbs.*	*Cu. ft.*	*Lbs.*	*Cu. ft.*	*Lbs.*
8	48	1680	56	1960	64	2240	72	2520	80	2800
9	54	1890	63	2205	72	2520	81	2835	90	3150
10	60	2100	70	2450	80	2800	90	3150	100	3500
11	66	2310	77	2695	88	3080	99	3465	110	3850
12	72	2520	84	2940	96	3360	108	3780	120	4200

(Kansas State College)

DAILY FEEDING REQUIREMENTS TO KEEP SILAGE FRESH (In pounds)

Diameter of Silo	*10 ft.*	*12 ft.*	*14 ft.*	*16 ft.*	*18 ft.*	*20 ft.*
Summer 3 inches daily.....	700	1000	1400	1800	2200	2800
Winter 1½ inches daily.....	350	500	700	900	1100	1400

ANIMALS FED DAILY WITH DIFFERENT SILAGE ALLOWANCES

Total Silage Fed Daily Pounds	*Number of Head*					
	40 lbs.	*35 lbs.*	*30 lbs.*	*25 lbs.*	*20 lbs.*	*15 lbs.*
400.....	10	11	13	16	20	27
800.....	20	23	27	32	40	53
1200.....	30	34	40	48	60	80
1600.....	40	46	53	64	80	107
2000.....	50	57	67	80	100	133
2400.....	60	69	80	96	120	160
2800.....	70	80	93	112	140	187
3200.....	80	92	107	128	160	214

HOW TO DETERMINE AMOUNT OF HAY IN BARNS AND STACKS

TABLE 1
CUBIC FEET PER TON OF HAY

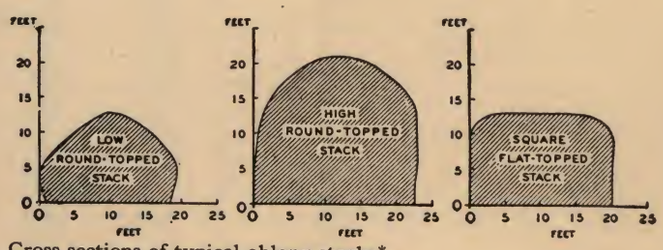
	Settled 1 to 2 mo.	*Settled over 3 mo.*
	cu. ft.	*cu. ft.*
Timothy.....	640	625
Wild Hay.....	600	450
Alfalfa.....	485	470
Clover.....	512	500
Chopped Hay.....	225	210
Baled Hay (closely stacked)....	150–200	150–200
Straw—Baled.....	200	200
Straw—Loose.....	1000	600–1000

Hay in Barns

Multiply the width by the length, by the height, of hay in the barn, all in feet, and divide by the cubic feet per ton shown in Table 1 to determine the total tons of hay in the barn.

Hay in Oblong or Rectangular Stacks

The three types of stacks are shown below with a rule for determining cubic feet content of each type:



Cross sections of typical oblong stacks*.

*U.S.D.A.

For low, round-topped stacks [(.52 times overthrow in feet) minus (.44 times width in feet)] times width in feet times length in feet equals cubic feet of hay in stack. (Overthrow is the distance from the ground on one side, up and over the stack and down to the ground on the other side.)

For high, round-topped stacks [(.52 times overthrow in feet) minus (.46 times width in feet)] times width in feet times length in feet equals cubic feet of hay in stack.

For square, flat-topped stacks [(.56 times overthrow in feet) minus (.55 times width in feet)] times width in feet times length in feet equals cubic feet of hay in stack.

The cubic feet of hay in the stack as calculated above, divided by the cubic feet per ton as shown in Table 1 equals total tons of hay in the stack.

Hay in Round Stacks

Measure the distance in feet around the stack and the overthrow in feet, then determine the cubic feet of hay in the stack by using Table 2 below:

MEASURING HAY IN STACKS

TABLE 2—*Volume of round stacks of hay of specified dimensions.*

Circumference (feet)	Indicated volume in cubic feet when the overthrow is— 25 feet	26 feet	27 feet	28 feet	29 feet	30 feet	31 feet	32 feet	33 feet	34 feet	35 feet	36 feet	37 feet	(Volume figures given to the nearest 5) 38 feet	39 feet	40 feet	41 feet	42 feet	43 feet	44 feet	45 feet	46 feet	47 feet	48 feet	49 feet	50 feet
45	825	960	1,090	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
46	840	975	1,105	1,235	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
47	855	990	1,120	1,250	1,385	1,505	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
48	870	1,005	1,135	1,265	1,400	1,525	1,650	1,785	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
49	885	1,020	1,150	1,285	1,420	1,540	1,670	1,805	1,935	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
50	900	1,035	1,165	1,300	1,435	1,560	1,690	1,825	1,955	2,090	2,215	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
51	915	1,050	1,180	1,315	1,450	1,580	1,710	1,845	1,980	2,110	2,240	2,370	2,495	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
52	930	1,065	1,200	1,330	1,465	1,600	1,730	1,865	2,000	2,130	2,265	2,400	2,530	2,665	2,795	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
53	945	1.080	1,215	1,345	1,485	1,615	1,750	1,880	2,020	2,155	2,290	2,430	2,560	2,700	2,835	2,975	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
54	960	1,095	1,230	1,360	1,500	1,630	1,770	1,900	2,040	2,180	2,320	2,460	2,595	2,735	2,875	3,015	3,160	.....	.....	.....	.....	.....	.....	.....	.....	.....
55	975	1,110	1,245	1,380	1,515	1,650	1,790	1,920	2,065	2,205	2,345	2,490	2,630	2,770	2,915	3,060	3,210	3,360	3,505	.....	.....	.....	.....	.....	.....	.....
56	990	1,125	1,260	1,395	1,530	1,665	1,810	1,940	2,085	2,230	2,375	2,520	2,660	2,805	2,955	3,105	3,255	3,415	3,565	3,720	.....	.....	.....	.....	.....	.....
57	1,005	1,140	1,275	1,410	1,550	1,685	1,830	1,960	2,105	2,250	2,400	2,545	2,695	2,845	2,995	3,150	3,305	3,465	3,625	3,785	3,940	.....	.....	.....	.....	.....
58	1,020	1,155	1,290	1,435	1,565	1,705	1,850	1,980	2,125	2,275	2,425	2,575	2,725	2,880	3,035	3,195	3,350	3,515	3,680	3,850	4,010	4,175	.....	.....	.....	.....
59	1,035	1,170	1,310	1,450	1,580	1,720	1,865	2,000	2,150	2,300	2,455	2,605	2,755	2,915	3,075	3,235	3,400	3,570	3,740	3,915	4,080	4,245	4,415	.....	.....	.....
60	1,050	1,185	1,325	1,465	1,600	1,740	1.885	2,020	2,170	2,325	2,480	2,635	2,790	2,950	3,115	3,280	3,445	3,625	3,795	3,975	4,150	4,320	4,490	4,670	.....	.....
61	1,065	1,200	1,340	1,485	1,615	1,760	1,905	2,040	2,195	2,345	2,510	2,665	2,825	2,985	3,155	3,325	3,495	3,675	3,855	4,040	4,215	4,390	4,570	4,750	4,925	.....
62	1,080	1,215	1,355	1,500	1,635	1,775	1,925	2,060	2,215	2,365	2,535	2,695	2,855	3,020	3,195	3,365	3,540	3,730	3,915	4,105	4,285	4,465	4,650	4,830	5,015	5,200
63	1,095	1,230	1,370	1,515	1,655	1,795	1,945	2,080	2,235	2,390	2,560	2,725	2,890	3,055	3,235	3,410	3,585	3,780	3,970	4,165	4,355	4,540	4,730	4,910	5,105	5,295
64	1,110	1,245	1,385	1,530	1,670	1,810	1,960	2,100	2,260	2,415	2,585	2,755	2,920	3,090	3,275	3,455	3,635	3,835	4,030	4,230	4,425	4,615	4,805	4,995	5,195	5,390
65	1,125	1,260	1,400	1,545	1,685	1,830	1,980	2,120	2,280	2,440	2,615	2,780	2,950	3,125	3,315	3,495	3,680	3,885	4,085	4,290	4,490	4,690	4,885	5,075	5,285	5,485
66	1,140	1,275	1,420	1,560	1,705	1,850	2,000	2,140	2,300	2,465	2,640	2,810	2,985	3,160	3,355	3,540	3,730	3,935	4,145	4,355	4,560	4,760	4,960	5,160	5,370	5,580
67	1,155	1,290	1,435	1,575	1,720	1,865	2,020	2,160	2,325	2,485	2,665	2,840	3,015	3,195	3,395	3,585	3,780	3,990	4,205	4,420	4,630	4,830	5,040	5,245	5,460	5,670
68	1,170	1,305	1,450	1,595	1,740	1,885	2,040	2,180	2,345	2,510	2,690	2,870	3,050	3,230	3,430	3,630	3,825	4,045	4,265	4,485	4,695	4,900	5,120	5,330	5,550	5,765
69	1,185	1,320	1,465	1,610	1,755	1,905	2,055	2,200	2,365	2,530	2,715	2,900	3,080	3,265	3,470	3,670	3,875	4,095	4,320	4,545	4,760	4,970	5,195	5,415	5,640	5,860
70	1,200	1,335	1,480	1,625	1,770	1,925	2,075	2,220	2,385	2,555	2,745	2,930	3,115	3,300	3,510	3,715	3,920	4,150	4,375	4,610	4,825	5,045	5,275	5,495	5,730	5,955
71	1,215	1,350	1,495	1,640	1,790	1,940	2,095	2,240	2,405	2,580	2,770	2,960	3,145	3,335	3,550	3,760	3,970	4,205	4,435	4,670	4,895	5,120	5,355	5,580	5,820	6,050
72	1,230	1,365	1,515	1,660	1,805	1,960	2,115	2,260	2,430	2,605	2,795	2,990	3,175	3,375	3,590	3,805	4,015	4,255	4,495	4,735	4,965	5,195	5,435	5,665	5,910	6,145
73	1,245	1,380	1,530	1,675	1,820	1,975	2,135	2,280	2,450	2,625	2,825	3,015	3,210	3,410	3,630	3,845	4,065	4,310	4,550	4,795	5,030	5,270	5,515	5,750	6,000	6,240
74	1,260	1,395	1,545	1,690	1,840	1,995	2,150	2,300	2,470	2,650	2,850	3,045	3,245	3,445	3,665	3,890	4,110	4,360	4,610	4,855	5,095	5,340	5,505	5,835	6,090	6,335
75	.....	1,410	1,560	1,705	1,855	2,010	2,170	2,320	2,495	2,675	2,875	3,075	3,275	3,480	3,705	3,935	4,160	4,415	4,670	4,915	5,165	5,415	5,675	5,915	6,180	6,430
76	.....	1,425	1,575	1,725	1,870	2,030	2,190	2,340	2,515	2,695	2,905	3,105	3,310	3,515	3,745	3,975	4,205	4,435	4,725	4,980	5,235	5,490	5,750	6,000	6,270	6,525
77	.....	.....	1,590	1,740	1,890	2,050	2,210	2,360	2,540	2,720	2,930	3,135	3,340	3,550	3,785	4,020	4,250	4,520	4,785	5,045	5,305	5,560	5,830	6,085	6,355	6,620
78	.....	.....	1,605	1,755	1,905	2,070	2,230	2,380	2,560	2,745	2,955	3,165	3,375	3,585	3,825	4,065	4,300	4,570	4,840	5,105	5,370	5,635	5,910	6,170	6,445	6,715
79	.....	.....	.....	1,775	1,925	2,090	2,250	2,400	2,580	2,765	2,980	3,195	3,405	3,620	3,865	4,105	4,345	4,625	4,895	5,170	5,440	5,710	5,990	6,255	6,535	6,810
80	.....	.....	.....	1,790	1,945	2,105	2,270	2,420	2,605	2,790	3,010	3,225	3,440	3,655	3,905	4,150	4,395	4,675	4,955	5,235	5,510	5,785	6,070	6,340	6,625	6,905
81	.....	.....	.....	1,805	1,960	2,125	2,285	2,440	2,625	2,815	3,035	3,255	3,470	3,690	3,945	4,195	4,440	4,730	5,010	5,295	5,575	5,855	6,145	6,425	6,715	7,000
82	.....	.....	.....	1,820	1,975	2,145	2,305	2,460	2,645	2,835	3,060	3,280	3,500	3,725	3,985	4,240	4,490	4,785	5,070	5,360	5,645	5,930	6,225	6,510	6,800	7,090
83	.....	.....	.....	.....	1,995	2,160	2,325	2,480	2,665	2,860	3,090	3,310	3,535	3,760	4,025	4,280	4,535	4,830	5,130	5,425	5,715	6,005	6,305	6,595	6,890	7,185
84	.....	.....	.....	.....	.....	2,180	2,345	2,500	2,690	2,880	3,115	3,340	3,570	3,795	4,065	4,325	4,580	4,885	5,190	5,485	5,785	6,080	6,385	6,675	6,980	7,280
85	.....	.....	.....	.....	.....	.....	.....	2,520	2,710	2,905	3,140	3,370	3,600	3,830	4,105	4,365	4,630	4,935	5,245	5,550	5,850	6,155	6,465	6,760	7,070	7,375
86	.....	.....	.....	.....	.....	.....	.....	.....	2,735	2,930	3,170	3,400	3,635	3,865	4,145	4,410	4,675	4,990	5,300	5,615	5,920	6,230	6,545	6,845	7,160	7,470
87	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,195	3,430	3,665	3,900	4,185	4,455	4,725	5,040	5,360	5,680	5,990	6,300	6,620	6,930	7,250	7,565
88	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,460	3,700	3,940	4,220	4,500	4,770	5,090	5,420	5,745	6,060	6,375	6,700	7,015	7,340	7,660
89	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,490	3,730	3,975	4,260	4,540	4,815	5,145	5,475	5,805	6,125	6,450	6,780	7,100	7,430	7,755
90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,765	4,010	4,300	4,585	4,860	5,200	5,535	5,865	6,195	6,525	6,860	7,185	7,520	7,845
91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,045	4,340	4,630	4,910	5,250	5,595	5,930	6,265	6,600	6,940	7,270	7,605	7,940
92	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,080	4,380	4,670	4,955	5,305	5,650	5,995	6,335	6,675	7,020	7,355	7,695	8,035
93	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,420	4,715	5,005	5,360	5,710	6,055	6,400	6,750	7,095	7,440	7,785	8,130
94	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,460	4,760	5,050	5,410	5,765	6,120	6,470	6,825	7,175	7,525	7,875	8,225
95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,805	5,100	5,465	5,825	6,180	6,540	6,895	7,255	7,610	7,965	8,320
96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,150	5,515	5,885	6,245	6,610	6,970	7,335	7,695	8,055	8,415
97	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,195	5,570	5,945	6,310	6,680	7,045	7,415	7,780	8,145	8,510
98	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,625	6,000	6,370	6,750	7,120	7,495	7,865	8,235	8,605

The cubic feet of hay in the stack as determined in Table 2 divided by the cubic feet per ton as shown in Table 1 equals total tons of hay in the stack.

U.S.D.A.

LIVESTOCK AND POULTRY FEED REQUIREMENTS

The amounts of feed listed in the following standards of feed requirements are for livestock receiving better-than-average care and management.

One pasture-day (a measure of pasture consumption occurring in several of the feed standards) refers to the amount of pasture consumed in one day by one "animal unit" receiving no other feed. An "animal unit" is one mature horse or cow or the equivalent in other grazing animals:

1 horse	2 yearling cattle	5 mature sheep
2 colts under two years old	2 weaned calves	10 weaned lambs
1 cow or mature bull	3 cattle on feed	15 spring or summer pigs

More protein concentrate than the amounts listed will be required if *low* protein concentrate is fed.

HORSES

Feed for 1 horse or mule (or 2 colts under two years old) for 1 year:

Corn.....20 bushels	Hay.....1½ tons
Oats.....35 bushels	Other roughage..1 ton
Pasture.....160 pasture-days	

BEEF CATTLE

Beef breeding herd—Quantities listed are for 1 animal for 1 year.

Kind	Without silage					With silage					
	Corn	Oats	Legume hay	Other roughage	Pasture-days*	Corn	Oats	Silage	Legume hay	Other roughage	Pasture-days*
	bu.	bu.	tons	tons		bu.	bu.	tons	tons	tons	
Cow	..	..	¾	1½	180	..	..	2	½	½	180
Bull, mature	10	10	2	...	180	10	10	1½	1½	...	180
Heifer, yearling	5	8	1½	...	90	5	8	2	½	...	90
Calf, to 1 year	4	4	1	...	60	4	4	½	¾	...	60

*In addition to pasturage obtained from stalk fields.

Fat calves—Quantities listed are for 1 unweaned calf to be marketed at about 10 months of age, weighing from 650 to 700 pounds:

Corn	20 bushels
Hay	125 pounds
Protein concentrate	75 pounds

Feeding cattle—Quantities listed are for 1 animal for the gain indicated.

Kind of cattle and starting weight	Gain	Without silage				With silage				
		Corn	Protein concentrate	Legume hay	Pasture-days	Corn	Protein concentrate	Silage	Hay	Pasture-days
	lb.	bu.	lb.	tons		bu.	lb.	tons	tons	
Fed in drylot										
Steer calves, under 500 lb.	500	55	225	¾	...	50	350	1¼	¼	...
Heifer calves, under 500 lb.	350	40	150	½	...	35	200	¾	¼	...
Yearling steers, 500 to 750 lb.	400	50	100	¾	...	40	200	1¼	¼	...
Yearling heifers, 500 to 600 lb.	250	30	75	½	...	25	150	¾	¼	...
2-year-old steers (medium grade) over 750 lb.	250	30	50	¾	...	15	150	2½	¼	...
Wintered largely on roughage; grain fed on pasture										
Steer calves, under 500 lb.	500	45	150	¾	50	35	250	1¾	¼	50
Heifer calves, under 500 lb.	350	30	100	¾	40	20	200	1¾	¼	40
Yearling steers, 500 to 750 lb.	400	40	100	1½	50	30	200	2½	½	40

Wood siding on barns, poultry houses and hog houses is warm in winter and cool in summer because of its insulating properties.

Your retail lumber dealer has plan books, working plans and specifications for farm buildings.

LIVESTOCK AND POULTRY FEED REQUIREMENTS—(Continued)

DAIRY CATTLE

Average of all breeds, assuming liberal use of good pasture. The quantities listed are for 1 animal for 1 year.

Class of cattle and production of milk (pounds)	Without silage*					With silage*					
	Corn	Oats	Protein concentrate	Legume hay	Pasture-days	Corn	Oats	Protein concentrate	Silage	Legume hay	Pasture-days
Cow	bu.	bu.	lb.	tons		bu.	bu.	lb.	tons	tons	
Under 6000	22	23	160	2½	180	13	21	225	3	1¾	180
6000 to 6999	24	28	200	2½	180	15	23	300	3	1¾	180
7000 to 7999	27	30	240	2½	180	17	25	375	3	1¾	180
8000 to 8999	29	32	275	2½	180	19	27	450	3	1¾	180
9000 to 9999	30	34	320	2½	180	21	29	575	3	1¾	180
10000 and over	32	36	370	2½	180	28	33	625	3	1¾	180
Bull, mature	12	12	150	2½	180	12	12	250	1½	1¾	180
Heifer, yearling	9	9	100	2	90	8	8	160	1	1¾	90
Calf, to 1 year†	5	5	60	1	60	5	5	100	½	¾	60

*The quantities of feed for dairy cows without silage were taken from dairy herd-improvement association records for 605 cows, 1936-1938, while the quantities of feeds for dairy cows with silage were taken from dairy cost records for approximately 5000 cows, 1936, 1937, and 1938. Dairy cows will require larger amounts of protein concentrates unless legume hay of good quality is fed.
†In addition, 200 pounds whole milk and 1200 pounds skim milk, or 800 pounds whole milk.

POULTRY

The quantities listed are for 100 birds for the period indicated.

Kind of poultry and feeding period	Corn	Oats	Wheat	Protein concentrate	Alfalfa meal
	bu.	bu.	bu.	lb.	lb.
Chicken hens, for 1 year	64	56	32	800	...
Pullets, to laying age	18	19	8½	375	...
Chicks, to 12-16 weeks	7	6	3½	200	...
Turkeys, to market age (24 weeks, semi-range)	32	35	16	1250	500

CORN SAVED BY HOGS FOLLOWING FEEDING CATTLE

	Percent of corn saved	Pounds pork per bushel of corn fed to cattle
Shock corn	20	2
Ear corn	15	1½
Shelled corn	10	1

University of Illinois

HOGS

Feed required for 1 hog to a market weight of 225 pounds, including pro rata share of feed for breeding stock.

	Corn	Oats	Protein concentrate	Alfalfa	Pasture-days
	bu.	bu.	lb.	lb.	
Spring and summer pigs	15	2	70	4	10
Fall and winter pigs	16	3	90	40	..

SHEEP

The quantities listed are for 1 animal for 1 year, or for the gain or age indicated.

Kind of sheep	Corn	Oats	Protein concentrate	Legume hay	Pasture-days
	bu.	bu.	lb.	tons	
Breeding ewes and rams	1	2	..	1/4	36
Early native lambs, to market at 4-6 months	¾	1	20	1/20	..
Western lambs, 20-30 lb. gain per head fed on pasture	1	2	..	1/40	9
Western lambs, 20-30 lb. gain per head fed in drylot	2	1	..	3/40	..

APPROXIMATE AMOUNTS OF MATERIALS REQUIRED PER CUBIC YARD OF CONCRETE**

Use of Concrete	*Mix*	*Sacks of Cement*	*Sand Cu. yd.*	*Gravel Cu. yd.*	*Largest size of gravel*
Most farm construction such as floors, steps, walks, tanks, silos, etc.	1:2¼:3	6¼	2/3	3/4	1½ in.
Concrete in thick sections and not subject to freezing. Thick footings and foundations, etc.	1:2¾:4	5	2/3	3/4	1½ in.
Thin reinforced concrete such as milk cooling tanks, fence posts, slabs 2 in. to 4 in. thick.	1:2¼:2½	6½	2/3	3/4	¾ in.
Very thin concrete as for lawn furniture, top course of 2-course floors, concrete 1 in. to 2 in. thick.	1:1¾:2¼	8	2/3	3/4	⅜ in.

**Amounts of sand and gravel required should be increased about 5 to 10 per cent to allow for waste and variations. (Portland Cement Association.)

APPROXIMATE AMOUNTS OF MATERIALS REQUIRED PER 100 Sq. Ft. of 1:2¼:3 MIX CONCRETE*

Thickness of concrete	*Concrete cu. yd.*	*Sacks of cement*	*Sand cu. yd.*	*Gravel cu. yd.*
4 in.	1-1/3	7-3/4	3/4	1
6 in.	2	11-2/3	1	1-1/3
8 in.	2-1/4	15-1/2	1-1/3	1-3/4
10 in.	3	19-1/3	1-3/4	2-1/4
12 in.	3-3/4	23	2	2-2/3

*Amounts of sand and gravel required should be increased about 5 to 10 per cent to allow for waste and variables. (Portland Cement Association)

APPROXIMATE AMOUNTS OF MATERIALS REQUIRED FOR HAND-MIXING OF CONCRETE

Where hand-mixing is employed correct proportions of materials for most small farm jobs may readily be determined by using this simple "recipe" where average moist sand is used:

2/3 pail of water,
1 pail of Portland Cement,
2-1/4 pails of sand, and
3 pails of gravel

WATER TIGHT CONCRETE

Material	*Quantity*
Cement	1 part by volume
Sand	2 parts by volume
Gravel	3 parts by volume
Hydrated lime	12 qts. to each 100 lbs. cement

MATERIALS REQUIRED FOR ONE CUBIC FOOT OF MORTAR*

Kind	*Mix by Volume*	*Cement*	*Hydrated Lime*	*Sand*
		Pounds	*Pounds*	*Cu. ft.*
Cement	1 cement: 3 sand	36.3	0	1
Cement plus 10 per cent of lime	1 cement: 1/10 lime: 3 sand	36.3	1.7	1
Cement-Lime	1 cement: 1 lime: 6 sand	18.1	7.4	1
Lime	1 lime: 3 sand	0	15	1

*U.S.D.A. Bul. 1869.

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